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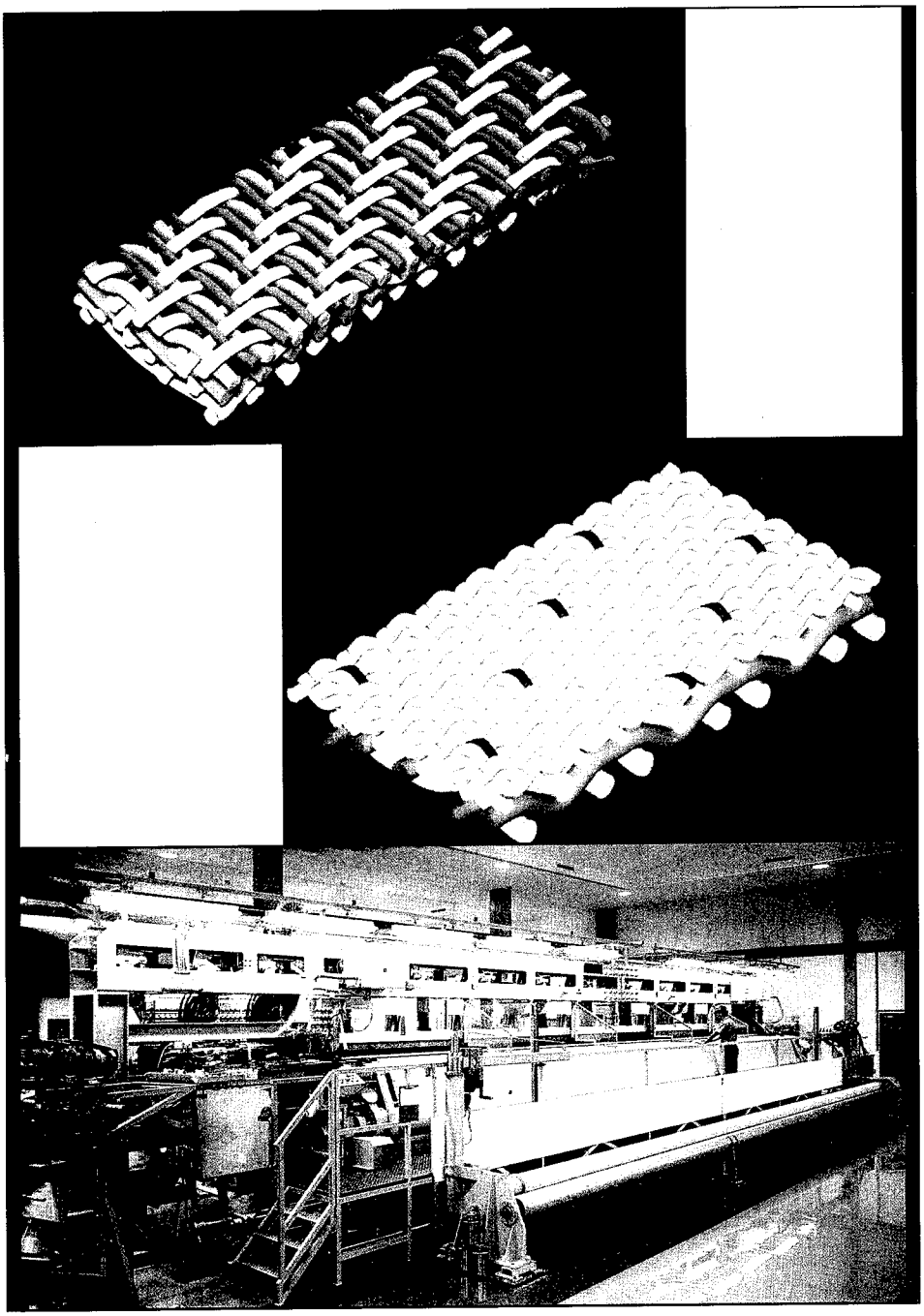
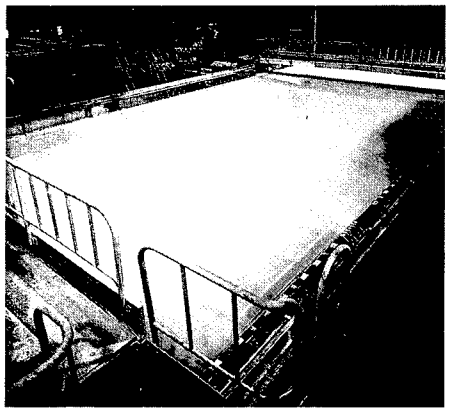


JETRO

NEW TECHNOLOGY JAPAN VOL.25 NO. 5

The aim of our magazine is to promote the international exchange of technology through the introduction of Japanese New Technology.



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Cover Photo: Synthetic Forming Fabric Plant for Pulp & Paper Mills — Shizuoka Plant of Nippon Filcon Co., Ltd.—(Story on Pages 2-5)

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KEIRIN 本印刷物は，日本自転車振興会から，競輪収益の一部である機械工業振興資金の援助を受けて作成したものである。

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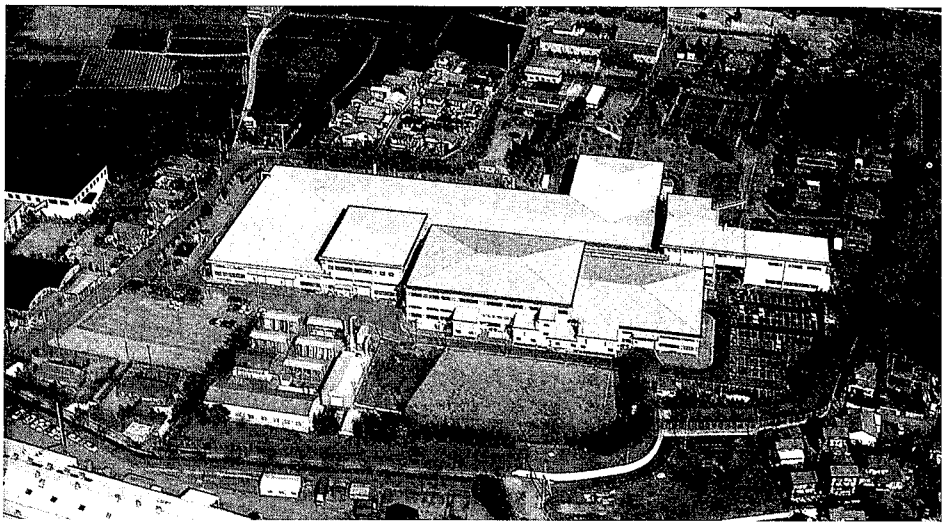
INNOVATIVE PRODUCTION NOW

This section describes a specialized section or whole process of a representative factory which excels in specific aspects of production.

Synthetic Forming Fabric Plant for Pulp & Paper Mills
—Shizuoka Plant of Nippon Filcon Co., Ltd.—

1. Introduction



Bird's eye view of the Shizuoka Plant

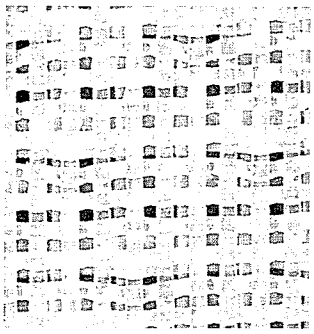
At one time the volume of paper used was regarded as the barometer of culture, but the present age of computers is called the paperless age. However, the production and consumption of paper are still high, so paper is still important in daily life.

Japan is a leading paper manufacturing country in the world, next only to the United States, and the trends in the production of paper in Japan during the last few years show that in 1994 the paper production volume was about 28,518,000 tons, in 1995 29,659,000 tons (up by about 4% compared with the preceding year), and in 1996 30,011,000 tons (up by about 4% over the year before).

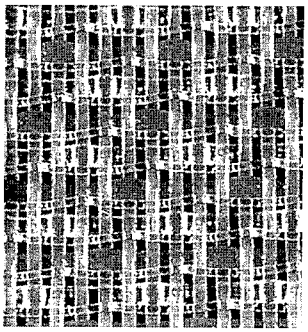
As of April 1997, there were a total of 951 paper making machines in operation throughout the country, with a daily paper making capacity of 57,405 tons. A breakdown of these machines gives 252 units of long-wire type paper making machines with a daily production capacity of 20,300 tons, 55 units of twin-wire paper making machines with a daily production capacity of 17,968 tons, 50 units of on-top paper making machines with a daily production capacity of 13,485 tons, and 594 units of other paper making machines with a daily production capacity of 5,650 tons. The long-wire type paper making machine is predominant and accounts for 26.5% of the total paper making machines in use, and 35.4% of the total daily paper production capacity. The operation rates of these machines were 94.9% in 1994, 99.9% in 1995 and 101.8% in 1996, with that for 1990 set as the base standard of 100%, indicating that these machines are generally in full operation.

Meanwhile, about 251 units of paper

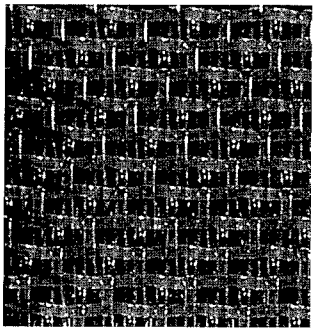
Synthetic Forming Fabrics for Pulp and Paper Mills



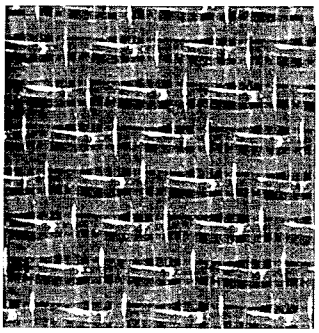
Triple-layer type



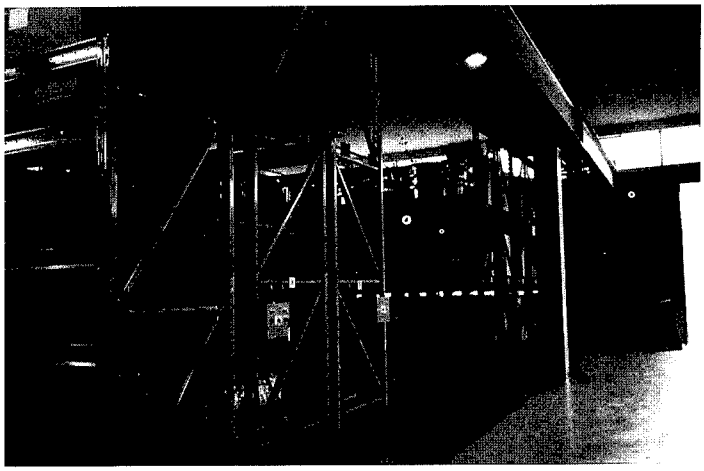
1.5-layer type



Double-layer type



2.5-layer type



Monofilament inspection and storage area

Warping and winding units

board making machines are in operation in the country, with a daily production capacity of 39,088 tons. Manufacturing paper board requires the equipment commonly called forming fabric (FF) in the trade, which is a netted equipment made of metal or plastics, and is installed at the place known as the wire part between the paper making machine pressurized head box and the wire outlet. The forming fabric (FF) has the following functions:

1) Receiving the paper raw material jetted out from the paper making machine head box (raw material pulp generally with a water content of about 99%).
2) Dewatering the raw material pulp on the forming fabric (FF) while retaining the paper fibers (normally called texture) uniform.
3) Transfer of dewatered raw material pulp to the press part.

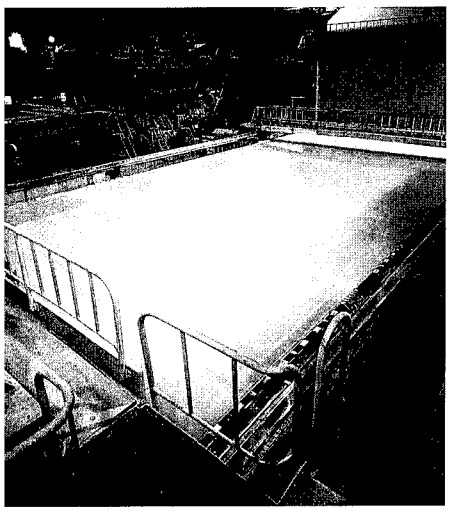
The quality of this forming fabric (FF) has a decisive bearing on the manufactured paper quality, and has profound influences on the paper making machines, and may therefore be regarded as extremely important in the paper manufacturing process. The forming fabric is generally available as metal forming fabric made of metal raw material or synthetic forming fabric [referred to as synthetic forming fabric (SFF)] made of plastics, primarily polyester. SFF was developed in about 1973 and the service life expectancy is 2-3 times longer than metal counterparts. Today, it is used by over 90% by paper making plants, so that this is the age of SFF.

This issue describes the Shizuoka Plant of Nippon Filcon Co., Ltd. that is the sole manufacturer of paper making forming fabrics (FF) in Japan and which is a pioneer in the development of SFF technologies in Japan. The company has a share of over 80% of the Japanese SFF market.

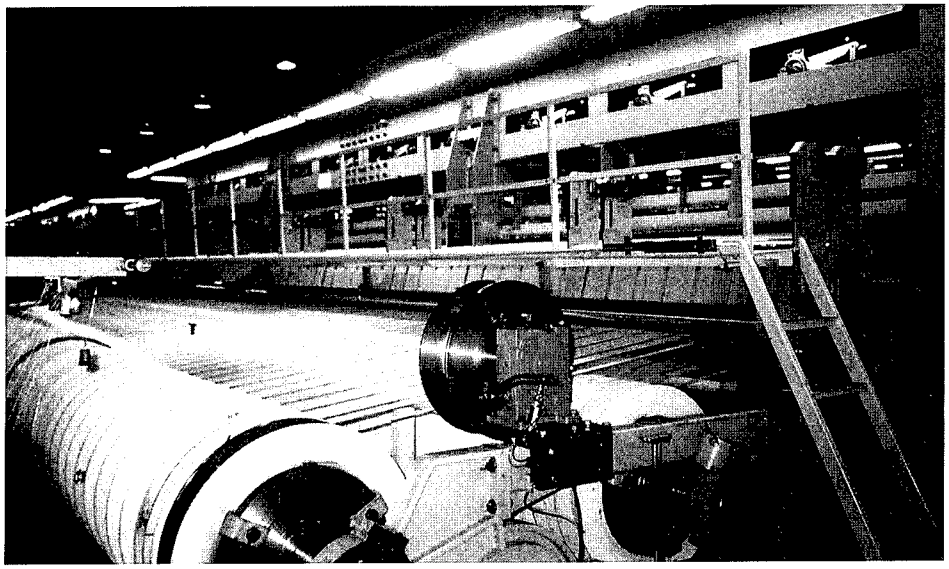
2. Description of Shizuoka Plant

This plant is located in Atsuhara, Fuji City, Shizuoka Prefecture, about 1 hour and 15 minutes from Tokyo to Shin-Fuji Station by Shinkansen Line, then a taxi ride for about 15 minutes to the plant lying on the plain below Mt Fuji. Fuji City is a paper making center in the country.

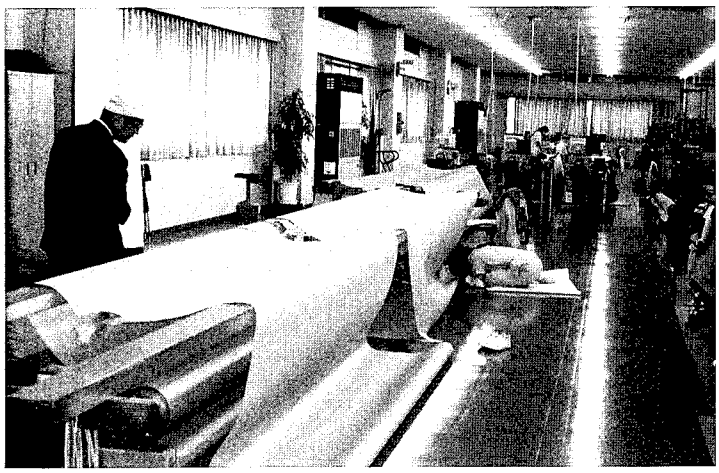
This plant was constructed in 1953, then expanded in 1987 when advanced facilities were introduced to its present modern state. The site is 81,698 m^2, the floor area is 23,899 m^2, and the labor force consists of 266 workers, or 139 males and 127 females, plus 42 part-timers. The main products are synthetic forming fabrics for paper making, of which production capacity is about 300,000 m^2. Polyester monofilament, the raw material, is consumed at a rate of about 300 ton/year, and the main production facilities are 33 weaving looms and 11 finishing machines.



Forming fabric used on the Fourdrinier paper machine



Large weaving loom



Automatic seaming operation

Semi-automatic seaming operation

3. Synthetic Foaming Fabric (SFF) Mfg. Line

(1) Production System and Importance of Technical Expertise

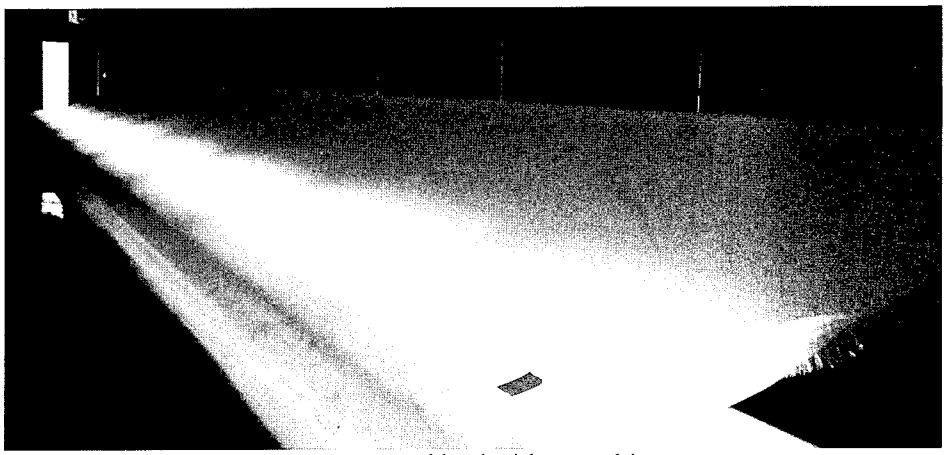
SFF is basically manufactured when orders are received from paper manufacturers, so the trade is based on the purchase order-based production system. The specific types of products and paper making machines are selected in conformance with the lengths and widths of each product, so the manufacturing mode is largely based on the method of producing specific products in several types.

Required quality of forming fabrics will be the ability of drainage, surface smoothness, stability, run performance, anti-abrasion, anti-pitch, retention, etc. These elements must be met with the exact target paper quality level. Therefore, every single forming fabric has been well managed and manufactured at this plant by the accumulated technical expertise on the process mentioned as follows.

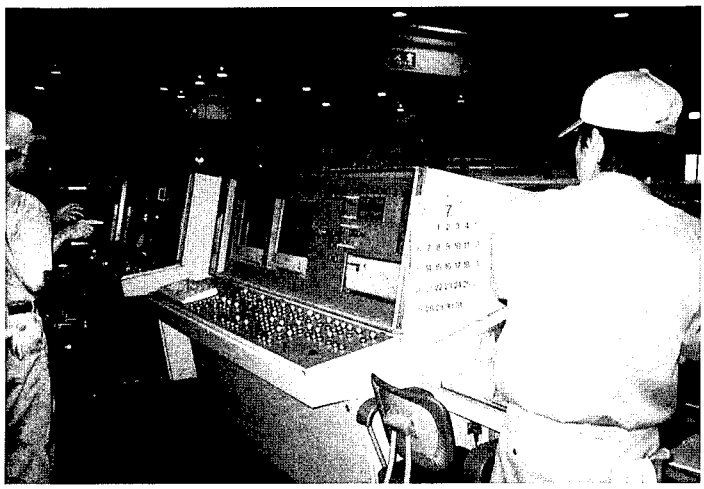
(2) Types of SFF

Since synthetic forming fabrics are pliable, many designs can be made. The forming fabrics presently used throughout the world can be categorized according to their structures as single layer (MONOFIL) which includes 1.5 layer, and multilayer (MULTIFIL) which includes double-layer, 2.5 layer, triple-layer, and triple weft-layer. The current main product at this plant is 2.5 layer forming fabrics which has a modified structure of double layer fabric to increase the number of fiber support index to improve retention, sheet formation and also the drainage capability by increasing void volume at wear side. These improvements can be done by arranging the number and material for warp and weft yarns.

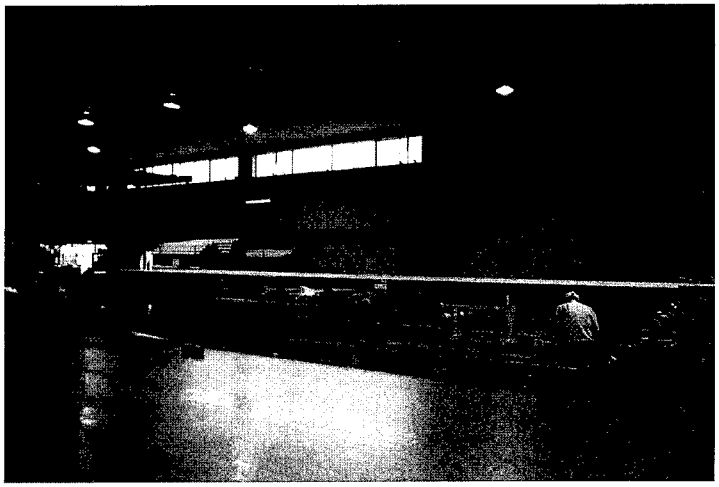
The most popular size of SFF is cur-



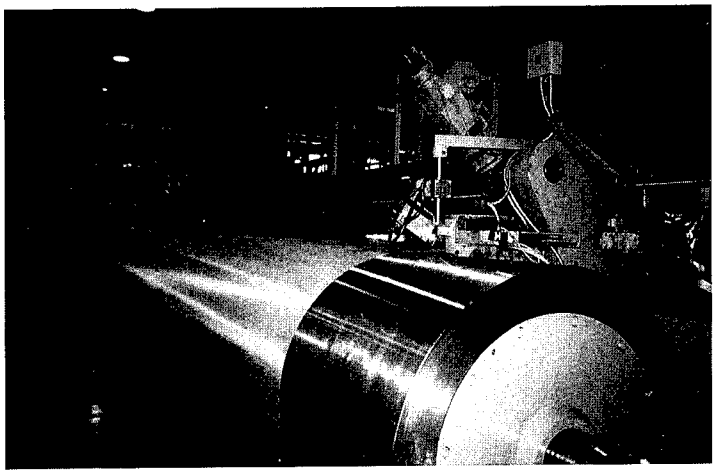
Optic inspection of finished forming fabrics



Automatic operation systems for finishing machines



Finishing operation of forming fabric



Finishing machine

Forming fabric seaming part at the finishing machine (white part)

rently less than 10 meter width with 30 to 40 meters length.

(3) Raw Material Procurement

Monofilament with a diameter of 0.1-1.0 mm is the raw material for manufacturing SFF, and filament manufacturers deliver raw materials which conform to the plant's specifications. Strict quality inspections have done when the filament arrived at the plant.

(4) Monofilament Winding Process

The monofilament passing the acceptance test is spun by the plant's unique winding and arrangement machines.

(5) Weaving Process

The weaving process essentially forms and determines the basic structure and character of forming fabrics and special technical expertise is necessary to arrange warp and weft with the exact indication of a fabric design.

(6) Seaming Process

Seaming process is to make the forming fabric endless. Precise work is necessary on this process, for example, about 280 numbers of 0.13 mm to 0.22 mm in diameter yarns are arranged per inch to make a 2.5 layer fabric endless. There are three different ways of seaming, hand seam, semi-automatic, and full automatic. Historically, it takes so much time on this process by hand seam though, the time has been shortened by the development and research of automatic seaming.

(7) Finishing Process

Staple sizing of forming fabrics are made in this process with giving high heat and stretching the fabric by two tension rolls. The size of forming fabric, even used on the high speed paper machines with the speed of 1,500 m/min. is stable because of passing this process.

(8) Inspections

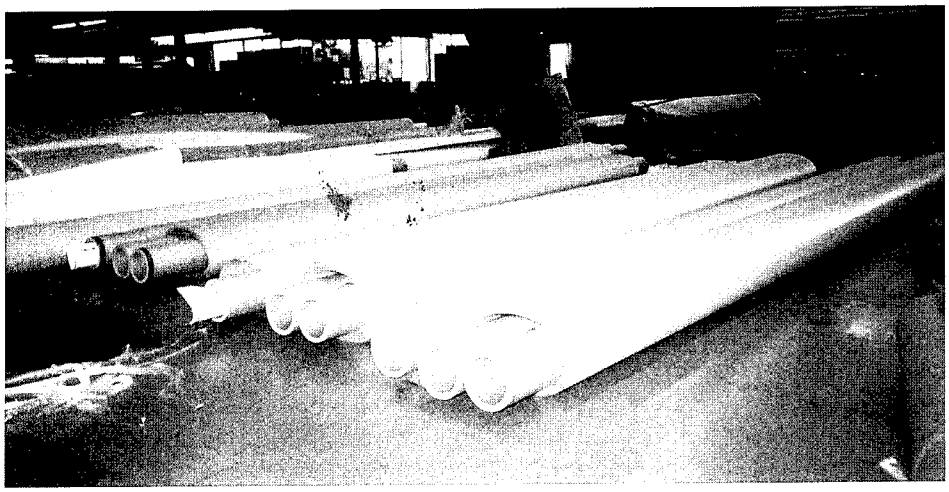
Strict inspection has been done on every single forming fabrics on its manufacturing processes; warping, winding, weaving, seaming, finishing, and packing.

4. Manufacturing Technology

The SFF manufacturing technology hardware involves intricate mechanisms which are difficult to understand by outsiders, and related software consists of the expertise acquired by the workers. Excellent products are produced by the delicate senses and accumulated skills of the female workers who have an average of 6.5 years experience in work demanding keen senses and nimble fingers.

5. Postscript

The Shizuoka Plant of Nippon Filcon Co., Ltd. manufactures products which may be regarded as the consumables of paper making, and therefore is an unfamiliar type of plant for people in general. However, the product is a vital industrial raw material that determines the paper quality and productivity of paper making plants. This plant merits our recognition whenever we read newspapers, use copying paper, facsimile paper or the other types of paper we are accustomed to see in our daily lives.



Forming fabrics ready for packing

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TOPICS

This section describes selected developments of special importance or interest due to the achievement of a breakthrough or innovation in technology.

World's Fastest Ferry Reaches Speed of 42.4 Knots —Delivered to Owner at MHI's Shimonoseki Shipyard—

MITSUBISHI Heavy Industries, Ltd. (MHI) has conducted trials of the high-speed single-hull ferryboat Unicorn, which reached the world's fastest speed of 42.4 knots for a steel ship with a diesel engine. The vessel was built at the company's Shimonoseki Shipyard for delivery to Higashi Nihon Ferry Co., Ltd., and the delivery was made on May 29 this year. She will be commissioned to run on the 115-km service route between Aomori and Hakodate from June 5, and is anticipated to shorten the time previously requiring 3 hrs and 50 min to about 2 hrs, about one-half compared with before. The ferryboat will also be making nighttime runs.

The conventional type of high-speed ferry was small and accommodated only passengers, but Unicorn will be transporting both passengers, cars and other large vehicles at the same time. She has been confirmed through trials to run at a high speed of 35 knots even in poor weather in waves as high as 3 m. This is the first high-speed ferry that can running at such a high speed even in poor weather. The high-speed single-hull ferry is expected to come into wide use as a carrier for intermediate-distance services to complement the services offered by conventional types of large ships and techno superliners.

The bridge has a steering system similar to that of an aircraft cockpit, so there is no steering wheel like those associated with conventional types of ships. Especially inside harbors, a joystick type control system using a single lever is employed that consists of a bow thruster at the bow and four units of water jet systems at the stern, which are operated simultaneously to arrive at and depart from piers most efficiently in a short time.

The passenger lounge is furnished with reclining seats equipped with audio earphones, which are aligned horizontally and vertically neatly in adequate spacing. The noise level is 55 phons in the upper passenger seats and 60-65 phons in the lower passenger seats, which provide a restful, noisefree space of the best achieved with a high-speed ferryboat. The vibration is also much lower than the lower level prescribed by the ISO International Standards, so passengers can enjoy their trips pleasantly and quietly.

Another distinct advantage is that the ordinary maintenance work can be performed with existing pier facilities, and that maintenance and repairs work can also be accomplished with ordinary dock facilities whenever necessary.

Unicorn has an overall length of 101 m, breadth of 14.9 m, depth of 10.3 m and the gross tonnage is 1,500 tons (Japanese admeasurement International gross tonage is about 3,500 ton). The accommodation capacity is 423 passengers, and 106 vehicles when only ordinary passenger cars are carried. Up to five large vehicles, including sightseeing buses, and 78 passenger cars can be carried. The main engines are four 8,840 HP diesel engines for working the four water jet systems forming the vessel's propulsion system.

This new high-speed ferryboat was developed by drawing on the high-speed, large car ferryboat building technologies which the company developed previously. To attain the world's highest speed of 42.4 knots, the hull is made of high-tensile steel and the bridge, passenger lounge are made of aluminum alloy to reduce the weight as much as possible.

Main Specifications of the Unicorn
Overall length:101 m
Overall breadth:14.9 m
Depth:10.3 m
Draft: 2.7 m
Gross tonnage:1,498 tons
(Japanese admeasurement)
Passenger capacity: 423 passengers
Max. speed: 42.4 knots
Cruising speed: 35 knots
Main engine: MTU20V1163TB73L

* ***Mitsubishi Heavy Industries, Ltd.***
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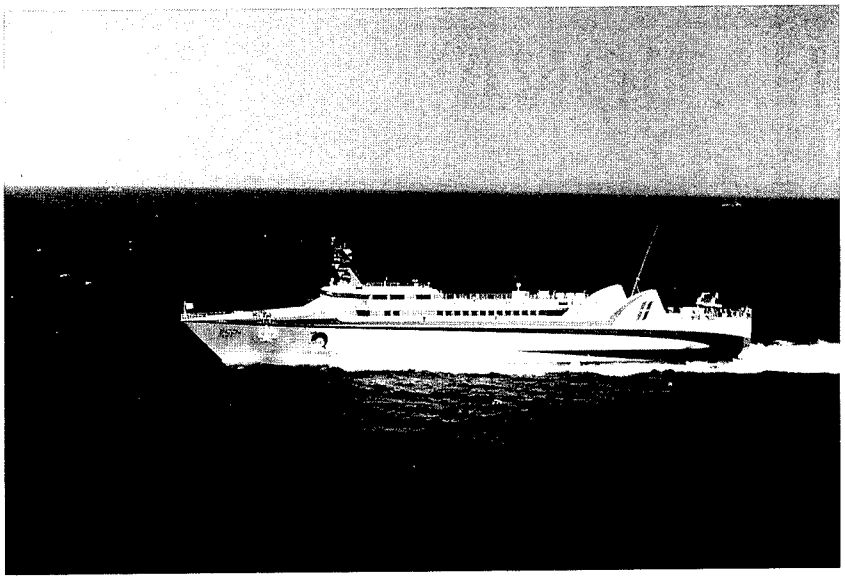

Unicorn

Three-Dimensional Teleradiology Using Stereoscopic Liquid Crystal TV

THE Dept. of Radiology at the Nagoya University School of Medicine has developed a stereoscopic liquid crystal video screen that provides real-time three-dimensional image viewing without special eye glasses. The first communicative experiment using the device was initiated in conjunction with Duke University Medical Center in the United States on February 11, 1997. This initiative is part of the Global Interoperabiliy for Broadband Networks Project by the G7 group of nations. A teleconference was successfully conducted and three-dimensional images of computed tomography (CT) and magnetic resonance (MR) were transferred using a high-capacity 156Mbps trans-Pacific network. Real-time communications were achieved, with the resolution of the stereoscopic liquid crystal video screen sufficient for observation of CT and MR images.

The device principally comprised a 10.4-inch color liquid crystal plate with a resolution of 640 × 480, an infrared lamp and camera to help identify the position of the viewer's head and a monochrome two-dimensional display used as a backlight. Several people could observe the three-dimensional images simultaneously without eye glasses.

The stereoscopic liquid crystal video screen should find applications in telemedicine.

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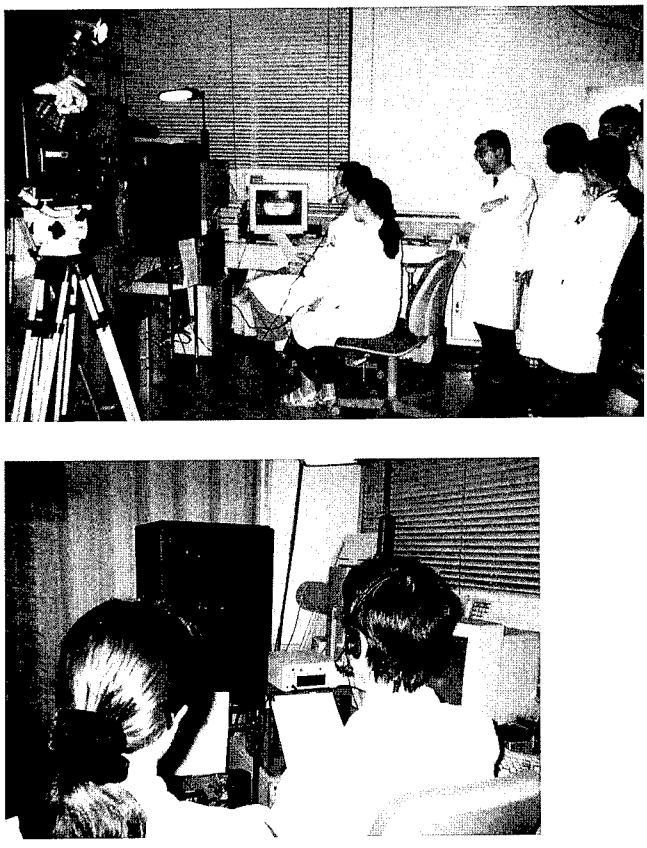


Teleradiology with 3D medical images using the steroscopic liquid crystal TV

NATIONAL R&D PROJECTS

This section describes various R&D projects being carried out in Japan on a national scale.

Technologies Applying Superconductivity

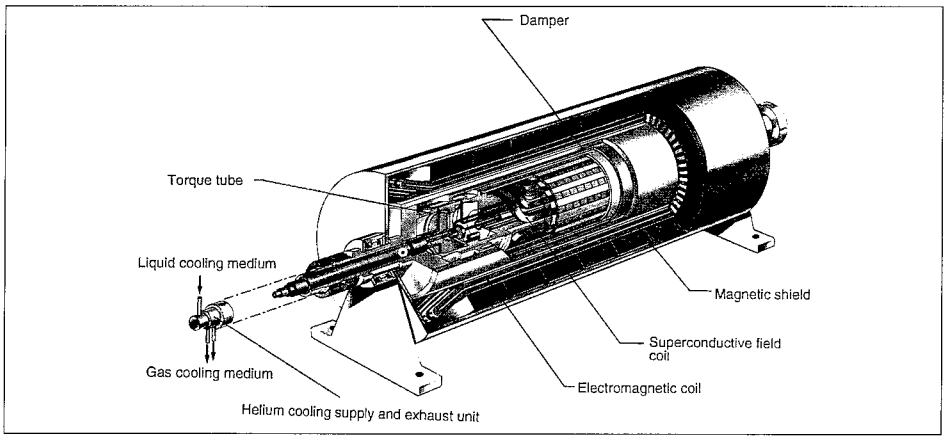
Superconductivity is the phenomenon in which a material loses its electrical resistance when certain conditions are met in connection with the magnetic field at a cryogenic temperature of lower than -200°C. Applying this phenomenon enables electric power to be transmitted with low loss or the generation of a tremendously strong magnetic field. Therefore, equipment difficult to produce by conventional technologies can be commercialized, such as magnetic resonance imaging (MRI) systems for medical treatment. Research is also being advanced in various fields to apply superconducting technology to the development of the magnetically levitated train system and other types of electrical equipment.

Electric power demand is increasing steadily from year to year and requires an increase and expansion of power generation and transmission facilities. However increasing capacities and erection of power plants at distant sites are leading to serious problems such as difficulty in securing sites for power distribution line facilities and stabilization of power systems. Effective solutions to these various issues require the introduction of power equipment and facilities applying superconductivity, such as the superconducting generator, as well as efficiency improvement and stabilization of power systems.

The objectives of the development of superconducting power generation technologies are commercial compact, lightweight and efficient power equipment as well as solutions to the issues associated with power systems, such as the need to stabilize power systems and to minimize losses. Therefore, an 11-year R&D project starting from FY 1988 was implemented to develop two types of low-speed and one type of superhigh-speed superconducting generators to serve as the predecessors of superconducting power equipment, superconducting wires for applications other than to generators, and high temperature oxide-based superconducting wires which are expected to be used in the future, as well as parallel research to develop highly reliable chiller systems for use with applied superconducting power equipment.

Research on the development of a superconducting generator that is central to this R&D project is in progress to develop a pilot generator (technology test generator), for which a 70,000-kW class model generator is presently under fabrication to establish basic design and fabrication technologies, which will be followed with demonstration tests to ascertain the reliability.

The introduction of the superconducting generator is expected to provide far-reaching effects compared with the use of the conventional type of generator. Firstly, the synchronous reactance will be lowered to 1/3-1/5 compared with existing machines, and power systems will also be stabilized to permit the power distribution tolerance limit to be increased by 1.3-1.5 times, which will eliminate the need for installing new power distribution lines. Secondly, power equipment will become more compact and lightweight to enable raw material and space conservation, and with the same size as existing generators, the superconducting generator output will be increased considerably. It will also become possible to commercialize large-capacity generators featuring weights and mechanical strengths which cannot be achieved with present types of generators. Thirdly, the improvement in the power generation efficiency (0.5-1%) will enable energy conservation and reduction of carbon dioxide (CO_2) emissions. All factors considered, the superconducting generator will be an extremely vital element to cope with the anticipated steady increase in power demand into the future.



Outline of Superconductive Generator

This R&D project is being advanced steadily, and in March 1997, the Second Intermediate Evaluation Report was drafted that stressed the necessity of establishing superconducting technologies applicable to power systems, especially the superconducting generator technology. It also clarified the nature of the R&D project, evaluated the R&D project and the results of research conducted previously, stressed the economic and social necessity of commercializing the superconducting generator, explained the progress of related R&D activities and proposed the direction for promoting related R&D activities into the future in conformance with the changes occurring in the social, economic and technical conditions.

Up till now, factory tests have been completed on two types of low-speed rotors and a commonly used stator for a 70,000-kW class model generator, and the stator was installed at the Demonstration Test Center (see accompanying Figure.). The rotors will be installed, adjusted and linked with a conventional type of chiller system for conducting demonstration tests. The superhigh-speed rotor will enter factory tests subsequent to fabrication.

Research on NbTi superconducting wires is increasing the conductor capacities to permit application as windings to AC equipment such as rotors, shunt reactors and current limiters, research is in progress on Nb_3Sn superconducting wires to develop excellent stability and use in strong magnetic fields. In addition, research on oxide-based superconducting wires is improving properties and increased capacities for application to power cables and power equipment such as current limiters.

Starting from this fiscal year, a new High-Temperature Superconducting Flywheel Power Storage Technology R&D Project was started as a link of the New Sunshine Program of the Ministry of International Trade and Industry as an application of superconducting technology. This flywheel power storage technology is a measure for load equalization, and aims to levitate a flywheel using high-temperature superconducting magnetic bearings with extremely low loss to store late nighttime electricity as flywheel rotary energy, then utilize the stored energy as electric energy when the power demand peaks in the daytime. The specific objectives of the R&D project are to develop basic technologies relating to the flywheel, revolution control, and a high-temperature superconducting magnetic bearing unit that combines a high-temperature superconductor and permanent magnets, to commercialize a high-temperature superconducting flywheel power storage system.

International Clean Energy System Technology Utilizing Hydrogen (WE-NET Project)

1. Project Background

The WE-NET R&D Project of the New Sunshine Program is a large joint international project to establish innovative technologies which are anticipated to contribute immensely to resolving energy and environmental control issues in the medium- and long-term perspective (beyond the year 2010).

The outstanding characteristics of hydrogen energy may be summarized as follows:

(1) Hydrogen is available through the electrolysis of water that is an inexhaustible resource, and is a clean type of secondary energy that is reconverted into water when combusted.

(2) Hydrogen has the largest energy concentration per unit weight among chemical substances.

(3) Electricity and thermal energy are difficult to store, but hydrogen can be stored with ease.

By capitalizing on these distinct characteristics of the hydrogen energy, the WE-NET R&D Project aims to utilize regenerative energy resources such as hydro power, sunlight and wind power available in the form of untapped resources throughout the world, to convert water into liquefied hydrogen and other forms enabling transportation with ease through electrolysis, and to transport and store these energy resources to the principal demand regions to establish an international network for the utilization of these energy resources in various fields in the sector of power generation, and as a transportation fuel and city gas, and to advance research to design an optimum total system as well as to develop innovative technologies for the manufacture, transportation, storage and utilization of hydrogen. (Refer to Conceptual Diagram).

2. Outline of R&D Project

(1) Project Description and Objectives

The project is presently in its First Stage (6 yrs, 1993-1998) to draft the basic concept of the total system establishing technologies enabling the introduction of an International (World) Energy Network System, and to develop related mainstay basic technologies.

(2) R&D Setup

In this R&D Project, the R&D themes are consigned to the respective research organizations by the New Energy and Industrial Technology Development Organization (NEDO). In the First Stage of the project, research is being implemented on the following nine subtask research themes:

1) General project evaluation, and survey and study of the R&D plan.

2) Survey and study of the method of project advancement under international cooperation.

3) Establishment of the conceptual design of the total system.

4) Development of hydrogen manufacturing technology.

5) Development of hydrogen transportation and storage technologies.

6) Development of technologies relating to cryogenic materials.

7) Survey and research relating to hydrogen utilizing technologies.

8) Development of hydrogen fueled turbine.

9) Survey and research relating to innovative, precursory technologies.

(3) Characteristics of Implementation of this Project

1) In view of the nature of this R&D Project, the research themes involve a wide diversity of technologies, making it necessary to advance research while engaging in project formulation. Therefore, a WE-NET Center has been established in NEDO that is in charge of Subtask 1, and the overall project is being adjusted under the leadership of the project leader.

2) An International Cooperation Department has been established for related studies to the entire WE-NET Project concept (Subtask 2).

3) Regarding themes which are innovative, precursory and highly promising but not selected for implementation under the R&D project, a study team has been established to enable these themes to be evaluated and adopted readily as research themes (Subtask 9).

4) To fully utilize the knowledge and capabilities of national research institutes, joint research is being advanced from FY1994 with the participation of the Mechanical Engineering Laboratory, National Institute of Materials and Chemical Research, Government Industrial Research Institute, Osaka, Government Industrial Research Institute, Chugoku (all belonging to the Agency of Industrial Science and Technology), the National Research Institute for Metals (Science and Technology Agency), and private sector enterprises and organizations.

3. Current Advancement of R&D Activities

(1) Development of Hydrogen Manufacturing Technology

Compared with the conventional hydrogen manufacturing process (alkaline water electrolysis process), the solid polymer electrolyte electrolysis process enabling efficiency improvement and compact design attained an energy efficiency of 90% of the target value with an electrode area of 50 cm^2 and current density of 1 A/cm^2.

(2) Development of Hydrogen Transportation and Storage Technologies

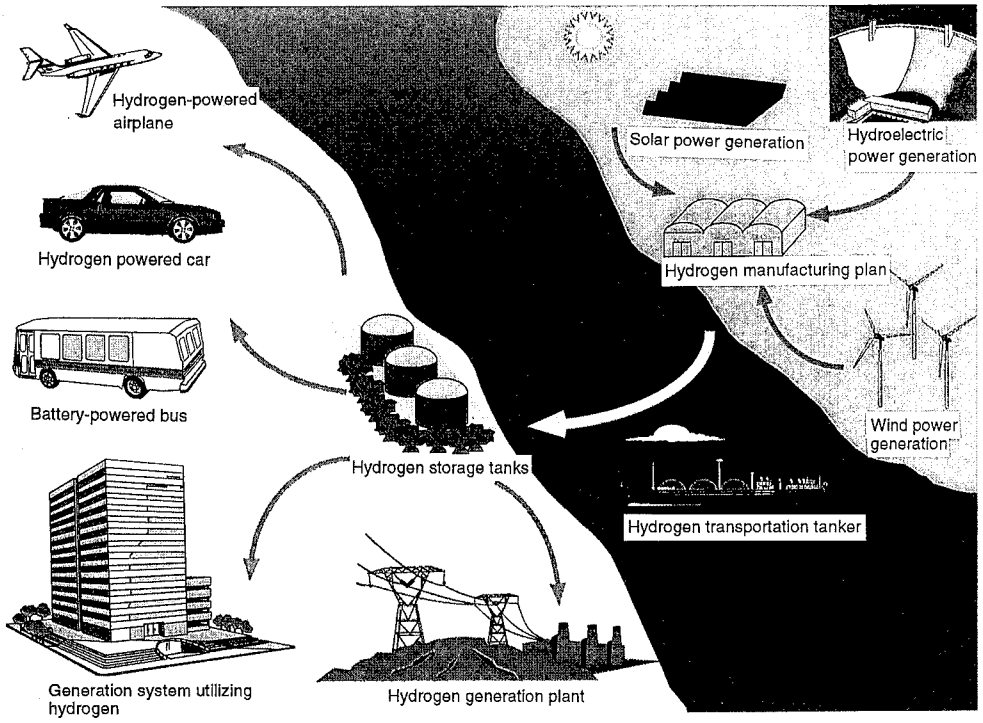
In the process of developing a large hydrogen liquefaction facility, studies of the liquefaction cycle (300 t/d liquefaction scale) revealed that a process efficiency of 40% can be attained theoretically for all liquefaction cycles.

(3) Development of Technologies Relating to Cryogenic Materials

The cryogenic characteristics of materials used in liquefied hydrogen structures (stainless steels, aluminum alloys) were elucidated.

(4) Development of Hydrogen Fueled Turbine

A conceptual design was drafted of a hydrogen-oxygen fueled turbine for power generation that is anticipated as a large-scale hydrogen utilization technology, and an outlook was acquired to attain the target power generation end efficiency of over 60% at a turbine inlet temperature of 1,700 °C.



Outline of WE-NET

4. Main Themes for FY1997

(1) Development of Hydrogen Manufacturing Technology

Tests will be conducted by increasing the electrolysis system electrode area to 2,500 cm^2.

(2) Development of Combustion Control Technology

Tests will be conducted on the hydrogen-oxygen combuston characteristics, and research will be advanced on the optimum combustion method and the basic structure of the combustor for hydrogen fueled turbines.

(3) Development of Technologies for Cooling the Blades and Rotors of 1,700°C Class Hydrogen Fueled Turbines

Turbine blades will be developed by using them in pressurized combustion testing facilities for testing.

5. Conclusion

This R&D Project is an integrated project involving a broad range of exploratory research and technology development related to hydrogen energy, so global scale cooperation will be necessary for the establishment of related concepts. Therefore, the greatest efforts will be made to encourage the participation of domestic and foreign research institutions with excellent R&D capabilities relating to these fields, and the results will be announced publicly to both domestic and foreign institutions and exchange will be promoted with related research institutions assuming a central role in this field of research.

To contribute to resolving the various issues relating to energy and environment control which will be faced on a global scale in the 21st century, this project should be advanced most actively, so the cooperation and assistance of all concerned are requested.

GENERIC TECHNOLOGY REVIEW

Research on the Structures and Functions of Biologically Active Sugar Chains and Lipids

Research to Directly Evaluate Functions of Simple Proteins

Research on Control of Cellular Information Transmission Functions

This section describes various basic research and development activities in Japan to inform the world about generic R&D efforts here.

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New Special R&D Theme for FY 1997

Research on the Structures and Functions of Biologically Active Sugar Chains and Lipids

National Institute of Bioscience and Human Technology

Biologically active sugar chains and lipids are vital as cell information transmittance substances and as a source of energy. However, biologically active sugar chains consist of simple sugars of very similar chemical structures, making structural differentiation quite difficult. Also, lipids are quite difficult to analyze due to their hydrophobic nature, so research on these substances are rather delayed compared with research on proteins and nucleic acids. In this research project, techniques relating to these sugar chains and lipids will be established, specifically a separation and analysis technique, a structural analysis and functional evaluation technique, and a modification technique, for application to the field of biotechnology.

Sugar chains combine with enzymes and other proteins and assist them to function properly. The sugar chains on cell surfaces undergo a change whenever cells become cancers, and sugar chains related to cancer mobility have been discovered. Infection by a virus such as influenza involves bonding of the sugar chains of the target cells with the virus protein. To determine the structures of these sugar chains, advanced analysis techniques have been established recently, such as the laser ionization mass analysis (TOF-MS) technique enabling identification of sugar chain size, and the nuclear magnetic resonance (NMR) technique enabling observation of sugar chain structures.

In this research project, these techniques will be applied to elucidate the structures of biologically active sugar chains of which identification had been quite difficult previously. Also, the NMR technique will be applied to analyze the interactions between sugar chains and substances which recognize sugar chains, with the objective of acquiring knowledge on the recognition action of sugar chains inside biological bodies.

Lipids are the principal components of biological membranes and assume the vital role of information transmission inside and outside the cell. In particular, diacyl glycerolacyltransferase (DGAT), a lipid synthesis enzyme inside cells, synthesizes lipids which produce lipidobodies which are the sources of energy inside cells, and have a pronounced influence on the membrane structures inside cells. DGAT is conceived to display an interaction with the activity of the lipid molecule that is believed to transmit information inside cells.

Therefore, the partial amino acid arrangement of DGAT isolated from hyphomycetes will be determined, followed with gene cloning, to elucidate the information transmission and interaction mechanisms in connection with lipid metabolism and biological membrane formation inside cells through analysis on the molecular level.

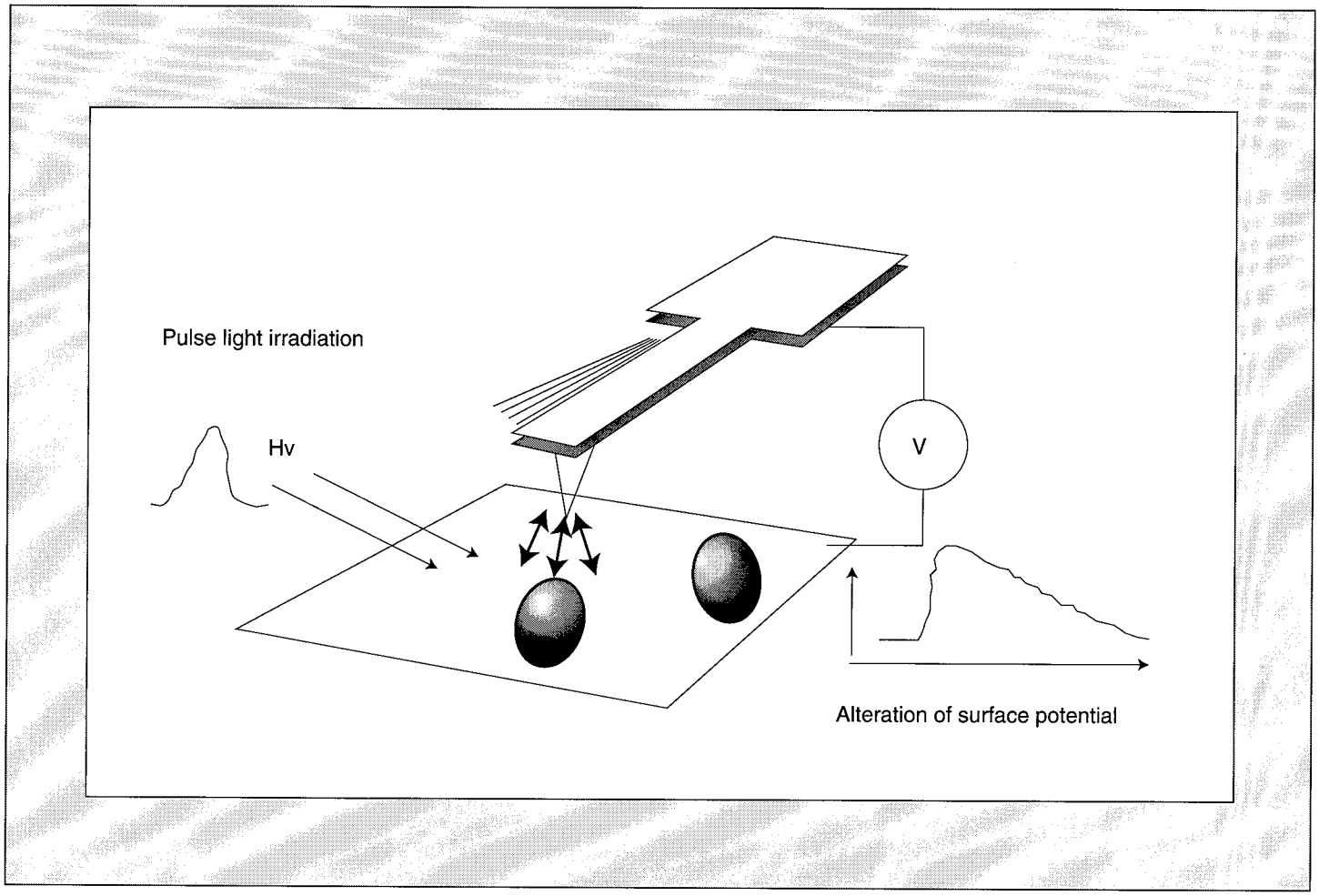
New Special R&D Theme for FY 1997

Research to Directly Evaluate Functions of Simple Proteins

National Institute of Bioscience and Human Technology

Understanding the mechanism of how simple protein molecules display their functions is linked to elucidating the intrinsic functions of biological molecules and is a highly interesting theme of research. It will be necessary to establish a fixation technique to control protein molecules to a target state as well as a technique to evaluate, on the simple molecular level, the functions of proteins fixed on a substrate.

In this research project, a scanning probe type microscope observation technique is applied to make detailed protein single-molecule level resolution observations in connection with protein mol-



Measuring alteration of surface potential by light irradiation

ecule specimens aligned on a substrate by the self-organizing method, with the objective of establishing a technique to analyze the dynamic functions by which these molecules display optical response or electron mobility.

The functional protein is a bacteriorhodopsin protein displaying an optical response function and a cytochrome protein displaying an electron mobility function, and research will be advanced to establish a technique to align and fix the proteins on a substrate, a technique to trace the dynamic light response function of a bacteriorhodopsin molecule with a scanning Maxwell stress microscope (SMM), and a technique to observe the electron mobility of a cytochrome molecule with an electrochemical interatomic force microscope.

The results of these research activities are anticipated to promote research on related dynamics when utilizing functional proteins as molecular machines, and can also be utilized in the development of devices for use as high-sensitivity biosensors.

New R&D Theme for FY 1997

Research on Control of Cellular Information Transmission Functions

National Institute of Bioscience and Human Technology

Cells, to maintain biological functions as a structural unit of animals and plants, and in simple organisms such as bacteria, transmit and receive various types of internal and external signals and undergo transformation in conformance with these signals. These cells discriminate, process and coordinate these signals, or respond to these signals on the cellular level or as a tissue or an independent body, by manifesting and controlling the functions of various internal and external functional molecules. These functions are coordinated in the most precise and intricate manner.

In order to elucidate the manifestation and control mechanisms of cell specific or tissue specific functional molecules, research will be advanced by using microorganism cells and animal cells with the objective of elucidating the characteristics and actions of functional molecules and related enzymes present inside cells, such as the functional RNA relating to gene DNA manifestation and control, the cell polarity control factors relating to cell directivity, proliferation control factors relating to cell proliferation, factors relating to cell ageing and non-mortality, myocardium cell pulsation control factors relating to the rhythmic activity of the heart, cell adhesion factors relating to intercellular information exchange, and factors relating to blood vessel activation and intestinal tract contraction.

The molecules controlling these cellular functions as well as the structures and characteristics of related molecules will be elucidated, and the control mechanisms of cell functions will be analyzed, with the objective of clarifying the mechanism of integration and signal response of functional controls on the cellular to tissue levels.

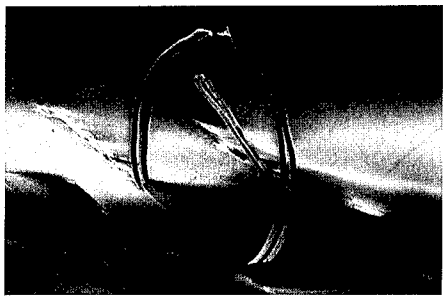
97-08-100-01

Supercompact Drive Mechanism Using Shape Memory Alloy

Prof. Hiroyuki Fujita of the Institute of Industrial Science, the University of Tokyo, jointly with the National Center for Scientific Research (CNRS) of France, have developed a supercompact drive mechanism using a shape memory alloy.

With this new mechanism, a titanium-nickel shape memory alloy is sputter deposited on a silicon substrate to fabricate a pair of thin plates 1,000 micrometers long, 30 micrometers wide and 10 micrometers thick. Each plate is removed from the substrate except one end. The two free ends are joined together to produce a ring-shaped mechanism. When the mechanism is heated by passing an electric current, it is deformed at a pace of 1-20 times/s and distorted by a width of 300 micrometers, and it is capable of moving objects weighing up to about 500 mg. This strength is about 50 times those of micromachines worked with static electricity and which are being used widely in various fields.

The research team observes that using several of such drive mechanisms in an assembly will permit the fabrication of a new type of transport system for moving various types of objects. For example, the glass wafers used for producing liquid crystal display systems are warped when used in a large area, so the development of some safe, reliable transport system had been in need. In this respect, utilizing this new mechanism will enable these glass wafers to be transported safely by supporting them with an assembly of these mechanisms.



A supercompact drive mechanism

The research team is presently giving study to a concept of aligning several such mechanisms on a floor and to develop a system to collect rubbish and dust in a corner of a room. The mechanism can also be fitted on the head (readout part) of a hard disk to prevent fusing of head and disk. The mechanism's superfine motions can also be utilized as for the positioning of optical fibers, so the research team plans to delve further into research to develop a broad range of applied products.

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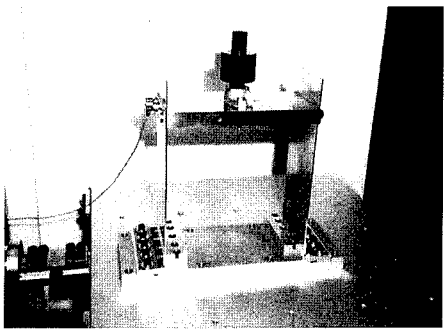
97-08-100-02

Rubber Pendulum Type Oscillation Damping System

Prof. K. Ozaki and his research team of the Faculty of Engineering, Tokai University, have succeeded in experimentally fabricating a spring system that is virtually completely free of resonance. The system is a "Rubber Pendulum Type Oscillation Damping System" with a rod-shaped rubber weight, and the rigidity of the leaf spring system itself has been increased by which the system's oscillation damping effect has been confirmed to be reduced to 1/25th compared with a non-damped system. It features an oscillation damping effect that is much greater than the one-third damping effect of conventional systems, indicating that the resonance phenomenon can be virtually eliminated completely.

With the experimentally fabricated spring system, a parallel leaf sping is mounted on the horizontal oscillation platform of the electrodynamic oscillation generator. The parallel leaf spring consists of a thick plate made of duraluminum, has a movable load of 1.12 kg and uses a pair of brass plates. Above the parallel leaf spring is mounted a rubber pendulum comprised of a pair of ring-shaped weights (each 0.2 kg) and made of round bar rubber (consisting of natural rubber (NR) and nitrile butadiene rubber (NBR)).

Above the parallel leaf spring, the ring shaped weights are not fitted on the round bar rubber, and sinusoidal sweep oscillation experiments (constant accelerated amplitude of 0.1 G, frequency range of 10-30 Hz), and the parallel leaf spring's resonance phenomenon was measured. As a result, the maximum accelerated amplitude at 20.3 Hz was 10.4 G, so the maximum vibration transmissibility (maximum accelerated amplitude/input accelerated amplitude = 10.4 G/0.1 G) was 104.



New oscillation damping system

In sweep acceleration experiments which were conducted by mounting ring-shaped weights of 0.4 kg on the rubber pendulum of the aforementioned parallel leaf spring, it was found that the resonance phenomenon of roughly 20 Hz was virtually eliminated completely by fitting weights on the rubber pendulum, and only two small crests were observed at near15 Hz and 24 Hz. Acceleration values of such small crests are generated at about 0.42 G, which means that the oscillation is damped to roughly 1/25th compared with when no weight is mounted on the rubber pendulum (non-damping). It was confirmed that at time of non-damping, the parallel leaf spring is oscillated to left and right considerably by resonance. However, at time of damping, the rubber pendulum is oscillated only slightly, but the parallel leaf spring itself is hardly oscillated. Based on this observation, it is conceived that it will be possible to establish a non-resonance spring mechanism.

When experiments were conducted by changing the rubber pendulum's round bar rubber material to nitrile butadiene rubber, it was found that there is an oscillation damping effect in the same manner as when using natural rubber.

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97-08-100-03

Recording and Playback of Concentrated Data Using Langmuir-Blodgett Film

Canon Inc. has established a technology to record and play back concentrated data using a Langmuir-Blodgett (LB) film that is regarded as highly promising for use as a molecular device material. Data are recorded by creating domains enabling smooth flow of electricity in dot mode with a scanning probe microscope (SPM), and the signals are read out in conformance with the presence or absence of an electric current. The recording density is maximum 1 Tbit/cm^2, equivalent to about 1,000 times that of the digital video disk (DVD).

The data recording medium is an LB film made of polyimide that is used as a heat resistant plastic. A thin film of 2.4 nm is laminated in six molecular layers on a gold substrate. A voltage is applied to the film by directing the tip of an SPM probe on the surface, by which electricity passes readily only at the superminiscule parts with a diameter of about 10 nm. These dot-like parts are aligned in a fixed spacing, then scanned with the same tip to read out the data.

An experiment was conducted successfully to write in about 1,000 points in an area measuring 2 μm horizontally and longitudinally. It was also confirmed that pseudo data can be recorded and played back by setting the points where a feeble current of about 1 nA flows as binary value 1 and the points without any current flow as value 0. In principle, a large-capacity recording medium of terabyte class can be developed in the size of a compact disk (CD).

At present, one point can be produced in two-millionth of a second. This can be shortened to a millionth of a second, which will raise the write-in speed to a practical level. The data readout speed is presently about 100,000 bits/s, or slow and running up to less than one-tenth that of a CD, but this can be improved by 100 times to enable high-speed readout by improving the scanning control method and by making the LB film surface smoother.

Several methods are being proposed for the development of next-generation version large-capacity memories, such as detecting light emitting organic molecules with an optical fiber and scanning a liquid crystal material with an SPM. Compared with these methods, the LB film enables the data write-in part to be produced most efficiently and features the characteristics of high-density recording.

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97-08-100-04

Lactoferrin Promotes the Phagocytic Activity of Human White Blood Cells

Morinaga Milk Industry Co., Ltd. has confirmed that lactoferrin present in breast milk and tears promotes the functions of neutrophils. The neutrophil is a type of white blood cell responsible for immune reactions and has the function of attacking and killing microorganisms, such as bacteria.

The phagocytic activity of human neutrophils in the presence of bovine lactoferrin (bLF) increased in a dose-dependent manner in vitro. Lactoferrin is an iron-binding protein and has the antibacterial action of sequestering iron that is indispensable for the viability of various kinds of bacteria. These findings provide further evidence that lactoferrin has an immunity activation in addition to its direct antibacterial effect.

The effects of bLF and its pepsin hydrolysate on the phagocytic activity of human neutrophils were examined by measuring the uptake of FITC-labeled latex beads. Neutrophils were prepared from fresh blood obtained from healthy volunteers and re-suspended in Hanks balanced salt solution (HBSS). Fifty microliters of the neutrophil suspension at a cell density of 5×10^6 cells/ml was incubated with 25 μl of HBSS containing the test substance for 15 minutes at 37°C. Then 50 μl of FITC-labeled beads at 5×10^7/ml were added to each cell suspension and the mixture was incubated for an additional 15 minutes at 37°C. The phagocytic activity of the neutrophils was analyzed by flow cytometry.

The phagocytic activity of human neutrophils was enhanced by bLF, and the stimulatory effect was not abrogated by hydrolysis with pepsin. Bovine lactoferricin® (bLFcin®), which is a bactericidal fragment purified from a pepsin hydrolysate of bLF (bLFH), also enhanced the phagocytic activity, while the fraction of bLFH depleted of bLFcin showed no stimulatory effect, indicating that bLFcin is the key peptide in bLFH responsible for activation of the function of neutrophils.

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97-08-100-05

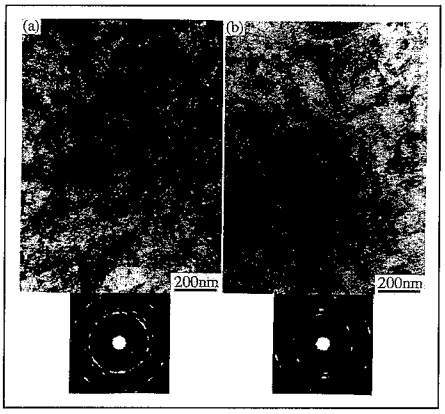
High-Strain Powder Metallurgy Process for Ultrafine Grained Alloy Powder

Prof. K. Ameyama and a research team at Ritsumeikan University have developed a high-strain metallurgy process for ultrafine grained alloy powder. The ultrafine grained powder can be sintered into an alloy of excellent mechanical properties.

The process is a type of non-equilibrium powder metallurgy method. The process starts with either alloy powder or a mixture of metal powders to be made into a target alloy. The raw powder is milled for hundreds of hours so that the material particles are repeatedly under the cycle of great strain and then relaxation. In those cycles, crystal grains of the material are recrystallized to ultrafine grain, and atomic bonds are broken so that the crystal structure is out of equilibrium. The non-equilibrium ultrafine grained powder is easy to sinter into a wide range of shapes including wires, coils and nets.

When a mixture of titanium (Ti) and aluminum (Al) powders was subjected under the 200-hour process, the product powder had grains of the TiAl alloy with quite a homogeneous composition. During the process, submicron recrystallizations of the target alloy take place in particles. As a consequence, the powder turns into a mass of small non-equilibrium crystals that cannot contain stable dislocations.

Another example is the common SUS316L austenitic stainless steel. After milling by the new process, the product alloy powder has crystal grains with a lot of dislocations and vacancies, because its stacking fault energy is too low to eliminate them. In addition, in the milled powder many rotated austenite particles are dispersed uniformly, and serve as nuclei of recrystallization when heated. The



In SUS316L stainless steel (a) mechanical milling powder(200hr), (b) 98% cold-rolled material TEM image

milled powder thus recrystallizes at a much lower temperature than cold-rolled stainless steel.

In a test, an SUS 316L stainless steel powder of 200-μm was milled. The product powder was molded and sintered to make a sample piece showing much greater mechanical strengths than an annealed bulk of the stainless steel. A tension test demonstrated that the yield strength and tensile strengths of the sample were 3.4 times and 2.2 times, respectively, as much as those of the bulk. It is noteworthy that in the test, the sample had an elongation of more than 30%.

The research team attributed those strengths to the sintered ultrafine grained powder having a microduplex structure where a small amount of σ phase was uniformly dispersed in a sea of austenitic crystal grains of less than 0.5 μm in diameter.

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97-08-100-06

New Type of Oxidation-Resistant Substance Discovered from Chrysanthemum coronarium

The National Food Research Institute of the Ministry of Agriculture, Forestry and Fisheries has discovered a new type of oxidation-resistant substance from Chrysanthemum coronarium that is commonly used as an ingredient for preparing various kinds of foods served in pots.

The substance's oxidation suppression effect is about the same as that of conventional types of oxidation-resistant substances, but it has a unique construction that is different from those of conventional types of oxidation-resistant substances deriving from chrysanthemums, so the development of some new function is anticipated.

The oxidation-resistant substance is observed as having the effect of preventing ageing and of suppressing the generation of activated oxygen that is regarded as causing cancer. The newly developed substance belongs to the family of a substance known as isochlorogenic acid. The chemical structures of the conventional type substance and the newly developed substance were investigated by analysis using related equipment. From the mass spectrum (MS) and nuclear magnetic resonance (NMR) spectrum, it was shown that the structures of both substances closely resemble that of the isochlorogenic acid contained in large quantities in coffee beans.

SP-1was analyzed as 3-,5-dicaffeoleicquinic acid and SP-2 as 3-, 5-dicaffeoleic-4-succinylquinic acid. SP-1 is a known compound, and SP-2 is a substance in which succinic acid is bonded with SP-1's 4th-position quinic acid, and whereas caffeoleic acid is newly bonded in the 3rd and 5th positions and succinic acid in the 4th position, a similar substance for the stone leek has different numbers and positions where caffeoleic acid and succinic acid are bonded. This raises the possibility that similar isochlorogenic acid derivatives are distributed widely in vegetables.

Chrysanthemum coronarium is a vegetable containing opulent quantities of carotene, minerals and fibers. The identification of the existence of an oxidation-resistant substance in it this time amply underscores the fact that it displays a new health sustenance function. Roughly 23 mg of the new substance exists in 100 g of Chrysanthemum coronarium, and the oxidation-resistant activity was about one-tenth that of the oxidation inhibition agent BHA used as a food additive. The research team plans to delve further into research with the objective of alleviating the changes in Chrysanthemum coronarium's oxidiation-resistant activity when it is served as a pot food as well as to eliminate its adverse influences to the stomach when it is eaten.

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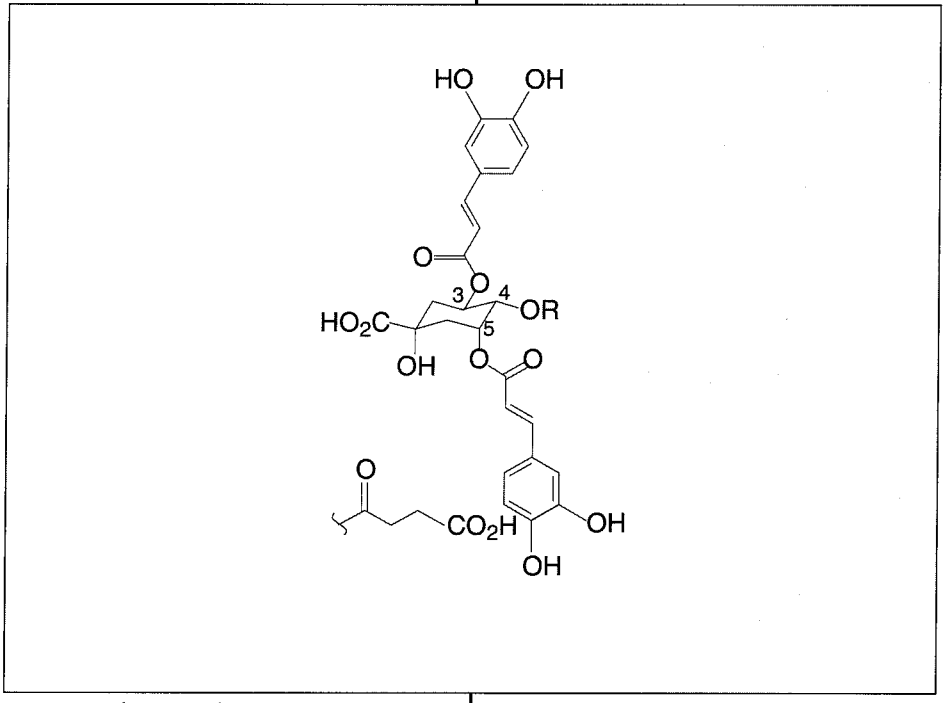

Structure of SP-1 and SP-2

NEW TECHNOLOGY & PRODUCTS

This section provides information about recently developed technologies and products, divided into Advanced Materials, Electronics & Optics, Information & Communications, Process & Production Engineering, Construction & Transportation, Energy, Environment, and Biotechnology & Medical Science.

Advanced Materials

97-08-001-01
Hard Composite Resin of Tremendous Strength for Producing Dental Crowns

Kanebo, LTD. has put on the market a hard composite resin "Eye Sight" featuring tremendous strength for use in the preparation of dental crowns. A distinct characteristic is that the resin is endowed with an enormous mechanical strength by the addition of a spherical inorganic filler consisting of superfine grains.

This UDMA-based composite resin is produced by adhering the surfaces of spherical 1.5-micrometer silica filler grains in orderly alignment with dense miniscule spherical 0.1-0.5-micrometer filler grains made of the same material by electrostatic force. This treatment has the effect of giving the resin a tremendous mechanical strength, surface hardness, wear resistance, color fastness and low water absorbency.

In addition, by using a monomer blended with metal and resin chemically, it is possible to eliminate the disadvantages associated with crowning plastics in general such as the poor adhesivity with metal frames as well as the inadequate strength of the body plastic that causes excessive wear and discoloration. The domestic retail price of a set of these materials is ¥110,000, and the company anticipates a sales revenue of ¥300 million in the initial fiscal year.

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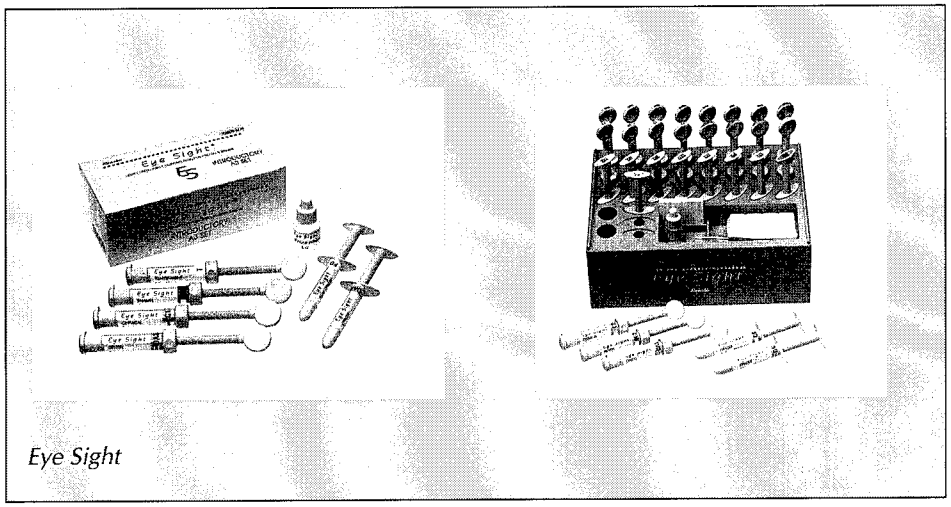


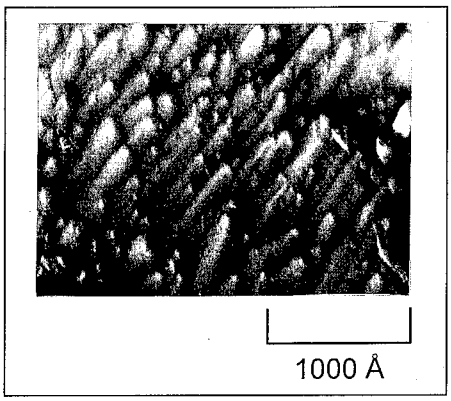
Eye Sight

97-08-001-02
New Soft Magnetic Material Featuring Both Single-Crystal and Polycrystal Properties

Prof. N. Hiratsuka and his research team of Saitama University have developed a soft magnetic ferrite (oxide magnetic material) that is produced by adding acicular geothite, manganese oxide and zinc oxide. Its magnetic properties feature those of both single-crystal and polycrystal ferrites. The acicular ferrite has been widely commercialized as a magnetic recording medium material, such as for audio and video tapes and floppy disks, but this is the first time that it has been developed as a soft magnetic ferrite for use in the fabrication of magnetic heads and transformers.

The new fine particles consist of acicular manganese zinc ferrite, and the starting materials are acicular geothite, to which manganese ions and zinc ions have been added, then the mixture calcined. Up till now, the acicular particles had been non-oriented. After calcium oxide and silicon oxide were added, they were pressed by the wet process method, a magnetic field applied, then calcined to obtain crystal-oriented manganese zinc ferrites.

The conventional type of single crystal manganese zinc ferrite has uniaxial anisotropy and high initial permeability but, on the other hand, the single-crystal ferrite works adversely in the high-frequency region to cause high-frequency loss since eddy currents are generated on the surface of the magnetic material. Therefore, with single-crystal ferrite, the initial permeability had been maintained at best only to about 500 kHz. By contrast, with the polycrystal ferrite, the initial permeability is low but no eddy current is generated in



Acicular manganese zinc ferrite

the high-frequency region, so there is the advantage of low loss.

The research team conceived the idea of orienting the polycrystal ferrite while retaining the characteristic magnetic properties of the single-crystal ferrite, or of adding calcium and silicon oxides by covering the peripheral parts of the grains with an insulating layer to retain the characteristic properties of the polycrystal ferrite even after orientation, with the objective of preventing frequency loss. Subsequent to calcining, the state of orientation of the acicular grains was observed with a transmission electron microscope, and their crystal phase was similar to that of the single crystal by X-ray diffraction.

By producing this oriented ferrite, it became possible to satisfy the three conditions necessary for a soft magnetic material, or of elucidating the saturation magnetic flux density that indicates the magnitude of the magnetic force, obtaining a large initial permeability that is sensitive to the external magnetic field from the initial stage, and maintaining the initial permeability up to the high-frequency region.

The soft magnetic ferrite generates a strong magnetic force even when a weak external magnetic field is impressed, and is applicable to the fabrication of magnetic recording heads as well as transformers for switching power units. This time, it was confirmed that there is a high-frequency domain of over 2 MHz that can maintain the state of high initial permeability.

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97-08-001-03

Aluminum Coated with Titanium Nitride by Ion Plating Process

Nihon Parkerizing Hiroshima Works Co., Ltd. and Hiroshima Prefectural Seibu Industrial Technology Center have jointly established a technology to coat aluminum with titanium nitride by the ion plating process.

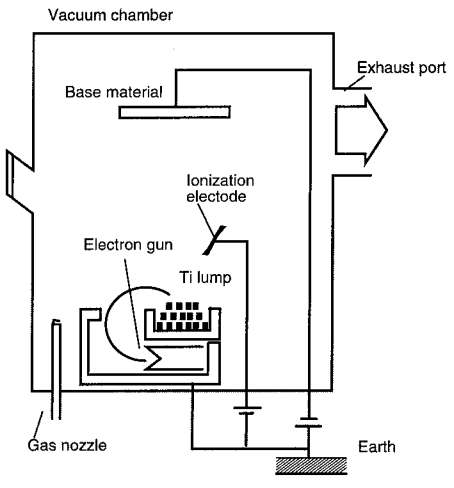
This surface treatment technology provides excellent wear resistance to aluminum that is a light metal, by which aluminum alloy dies are made much more wear resistant, while automotive parts, aircraft and space vehicle parts as well as the sliding parts of precision equipment are made lightweight and their inertial forces improved, enabling these parts to conduce to energy conservation and to working at higher performances.

When aluminum structural members are given titanium nitride coating intact by the ordinary ion plating process, the internal stress of the titanium nitride coating denatures the aluminum material to cause the titanium nitride coating film itself to undergo fine cracking, but when coating is performed with the new technology, a nickel-phosphorus plated layer is formed that displays the effect of alleviating the stress of the titanium nitride coating, with the result that cracking is prevented.

The Suga type abrasion test (JIS H 8503) showed that the treated aluminum surface displays a definitely effective wear resistance compared with other surface treatment methods. This indicates that the titanium nitride film featuring superlative hardness of roughly 2,400 HV is adhered firmly with the aluminum material. With a soft metal, a thin surface hardening layer causes a denaturing of the material itself when exposed to friction with a heavy load to promote wear, but with this new surface

TiN(3μm)/Ti(0.1μm)/Ni-P(20μm)

TiN(3μm) only



Ion plating process equipment

treatment technology, an intermediate nickel-phosphorus plated layer that is comparatively thick and hard (roughly 550 HV by electrolysis or non-electrolysis treatment) is generated that provides the material with an excellent wear resistance even with respect to comparatively cruel wear conditions.

The research team observes that the new coated aluminum can be put to diverse applications as a new type of material since the material features aluminum's lightness plus excellent wear resistance.

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97-08-001-04
Cotton Stretch-Processed Weaving Material

Kanebo Spinning Corporation will be marketing from autumn this year a stretch-processed weaving material Techno Fit consisting entirely of cotton, featuring long stretch retention and available at a moderate price. It will be used to produce shirts, blouses, coats and blousons for use in the spring and summer of 1998.

The new products feature an appropriate elongation to provide a comfortable body fit, and the elongation is not changed even with wear. When cotton yarn is woven, the yarn tends to become wavy, but the company devised a new process to eliminate this waviness and to give a stretch property to the yarn. The new weaving material will be made available at a price that is lower than that of ordinary stretch materials.

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Electronics & Optics

97-08-002-01
Basic Technology for High-Capacity Optical Disk Recording and Playback

Sony Corp. has developed the technology for a next-generation, high-capacity optical disk with recording and playback capability. A storage capacity of 12 gigabytes has been achieved on a 12cm-diameter disk, the same size as a conventional CD. This high capacity was made possible through a newly developed high-power blue-green laser, a two-element objective lens with a high numerical aperture, and a 1.2cm-thick disk with a 0.1mm-thick transparent protective layer through which recording and playback take place.

Extreme miniaturization of the laser beam spot of the new disc to 0.7 microns in diameter was achieved through a high-power blue-green semiconductor laser with a wavelength of 515 nanometers and output power of 20 milliWatts, and a two-element objective lens with numerical aperture of 0.85. The recording/playback method uses a physical disk structure with a 0.1mm-thick transparent protective layer that corresponds to the high-numerical-aperture lens. This structure reduces aberration due to tilt of the disk, improves the error rate in reading and boosts recording density to more than 10 times that of a compact disk while enabling two-sided recording. Both playback and recording of data are possible through the high-power semiconductor laser by use of either a phase-change material to record the signal by crystallizing the recording material to alter the reflectivity rate of the disk, or a magneto-optical material to record the signal with a laser using magnetic modulation.

These developments yield a recording density of 9.5 gigabits per square inch on a 12cm disk with a storage capacity of 12 gigabytes per side. Furthermore, the new technologies render possible the recording of such high-bit-rate video signals as high-definition television signals on an optical disk with high access rate. The company believes that such breakthroughs should lead to new ways to use and enjoy home-use video recording products.

Sony will proceed with development to realize these technologies in a product. Foci include lengthening the life of the laser and developing format specifications. The company will also continue research and development to enlarge disk capacity with the use of gallium-nitride blue-green laser with a wavelength of approximately 410 nanometers, targeting the theoretical capacity 18 gigabytes on a single-sided disk and 36 gigabytes on a double-sided disk.

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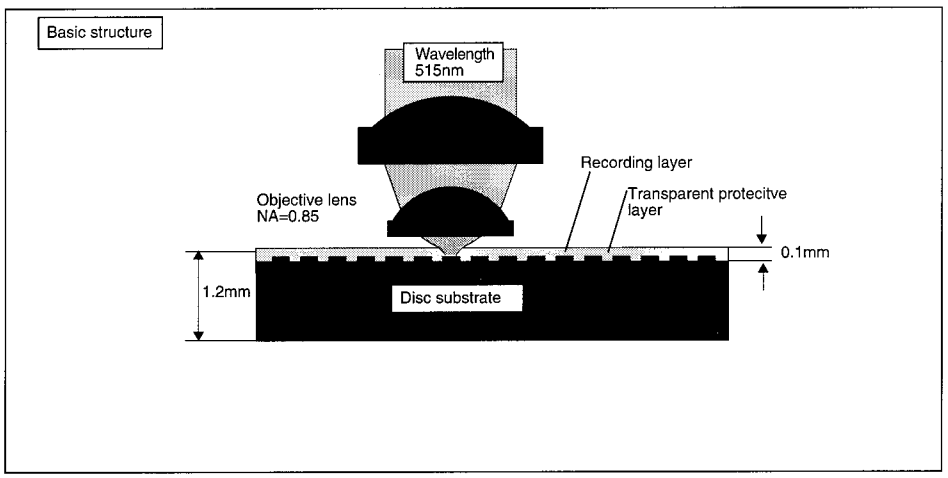

97-08-002-02

Tape Halves Portable Telephone Electromagnetic Emissions

Taniyama & Co., Ltd., an importer and sales agent for imported farm products, has developed a tape that can halve the emissions of electromagnetic waves generated by portable telephone units. The mechanism consists of neutralizing and absorbing the electromagnetic waves with built-in ceramic crystals. The newly developed Barianswer Tape consists primarily of silicon and incorporates ceramic crystals and platinum components. It is 10.7 cm long, 6 mm wide, 1 mm thick, and pasted on the rearside of a portable telephone set.

Microwave tests by an authorized testing organization indicated that the magnetic waves are attenuated by 66.1% and 85.5%, respectively, at spots 5 cm and 30 cm away from the portable telephone. This effect is due to the special type of ceramic crystals aligned in dispersion inside the tape which react with the electromagnetic waves as a semiconductor. As a result, the variable magnetic field that is harmful to the human body is transformed into a static magnetic field. The Barianswer Tape also adjusts slight frequency dispersions from instant to instant for radio wave switching, and since no electromagnetic noise is generated, the communications quality is not impaired in any way.

The company, in the process of a soil improvement project, became aware that ceramic materials have the effect of absorbing magnetic waves. Research studied the correlation between crystal materials and other types of materials, and succeeded in increasing the tape electromagnetic wave absorption effect.

The tape is sold at a domestic price of ¥3,800 apiece, and the company anticipates a sales revenue of about ¥3 billion in the initial fiscal year.

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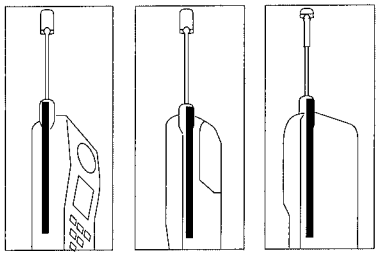
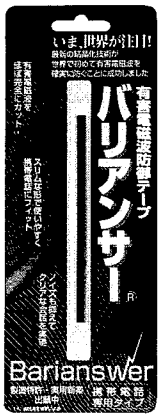
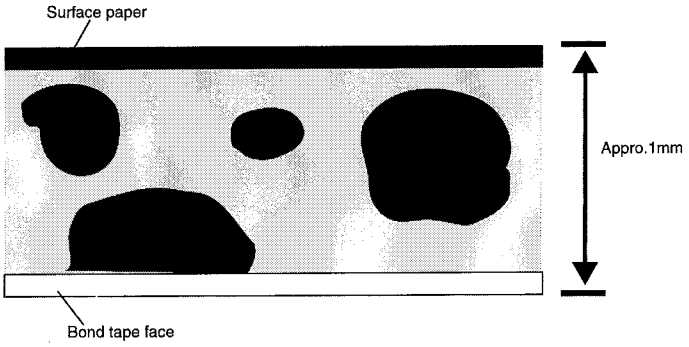
How to use the product





Barianswer

Structure of Barianswer



97-08-002-03

Taped Media Recording and Playback Thin-Film Head Using Rotary Drum

Victor Co. of Japan, Ltd. has developed a taped media recording and playback thin film head using rotary drum.

The thin-film head enables recording and playback at high frequencies as well as recording and playback with tapes of narrow tracks, and is therefore suitable for high-density digital recording, so has been used as a hard disk drive (HDD) head for several years. By contrast, the bulk head is used in general not only as a recording and playback head for audio and video magnetic tapes but also as a recording and playback head for data recording tapes. This is because the HDD is used without contact between disk face and head, while with taped media the magnetic recording face and head are in contact, so that the use of thin film heads involves several problems such as rapid wear of the head.

If it was possible to apply the excellent characteristics of the thin-film head to magnetic tape recording and playback, then the way will be paved for high-density digital recording and playback with tapes. Perceiving this possibility, the company had been engaged in related technology development, which resolved the three major issues concerned with the utilization of the thin-film head as a tape media, and developed the world's first recording and playback thin-

film head using rotary drum for taped media, and excellent characteristics have been confirmed through prototype systems.

With the new product, the magnetic circuit is designed by taking into account the head wear caused by tape tracing beforehand. To prevent the lowering of recording capacity due to this design, a new magnetic material made of iron nitride was developed and used that has the highest saturated magnetic density of 1.9 T.

The first all inorganic material head fabrication process was developed that provides the head with excellent heat resistance properties, while the pasting of protective portion indispensable for producing the head shape for tape-running is possible by glass bonding of high reliability, by which the dust adhesion problem has been resolved. Further, the use of a unique substrate has resolved the problem of the head part metals being worn quickly when using the conventional type of basic materials for producing HDDs.

The application of the thin-film head as a taped media enables high-density operations of VTRs and data processing systems, also enables the use of multiple heads and easens working with digital signals. The company plans to apply this new technology to the development of high-density digital recording systems as well as to the establishment of a new device business.

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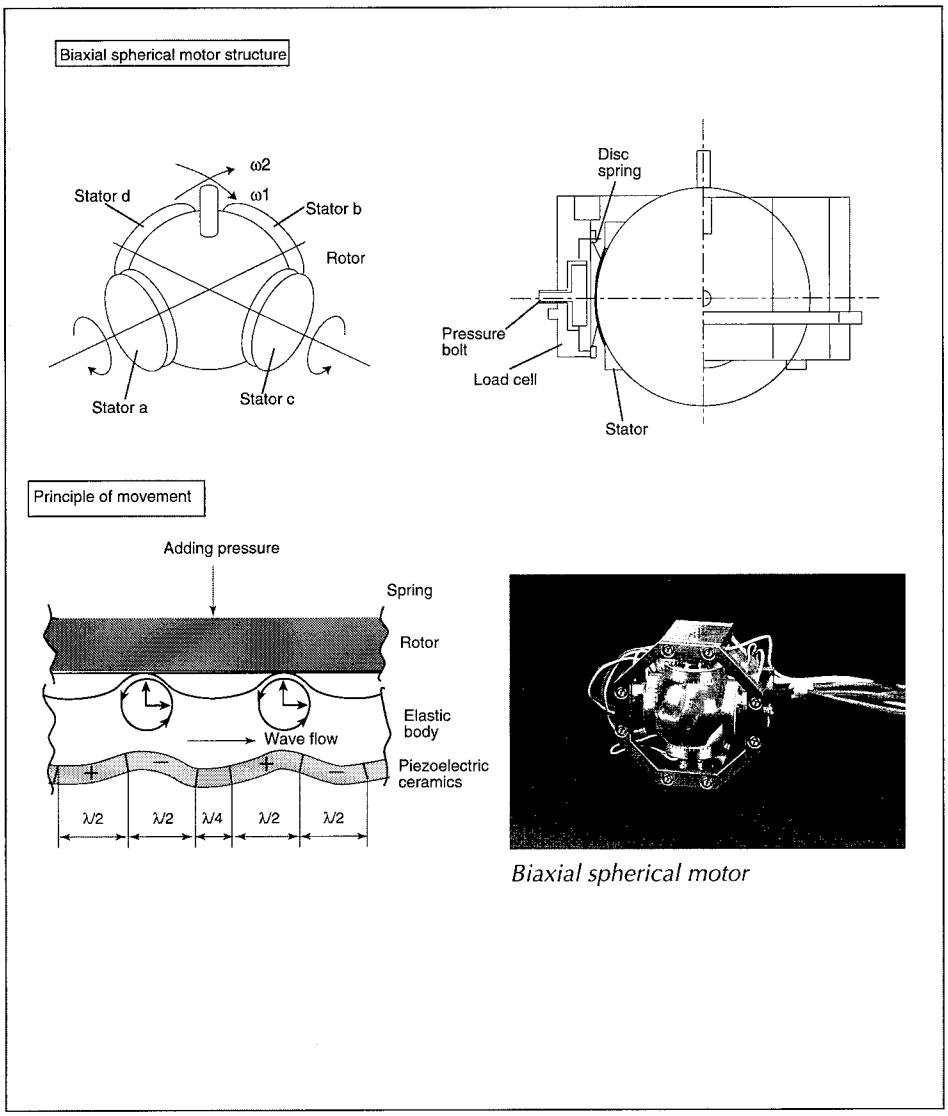

Biaxial spherical motor

97-08-002-04
Biaxial Spherical Motor with Ultrasonic Wave Drive

Robotmation Co., Ltd., Prof. S. Toyama of the Tokyo University of Agriculture and Technology and a research team, have jointly developed and commercialized an Ultrasonic Wave Drive Biaxial Spherical Motor. Up till now, a single-axis ultrasonic wave drive spherical motor had been available, but the biaxial version is the first of its kind. The motor can move not only vertically but laterally as well.

The ultrasonic wave motor, compared with ordinary magnetic motors, is more compact, lightweight and has a larger torque, but existing uniaxial ultrasonic wave motors move only in one direction and heat is generated by friction, so continuous operation is difficult. The biaxial type commercialized this time applies the principle of the travelling wave type ultrasonic wave motor and uses its directivity angle of two degrees of freedom to drive and control the spherical rotor optionally and flexibly. The rotor functions as a human's eye.

The travelling wave type ultrasonic wave motor does not use electromagnetism that is the principle of the drive of ordinary motors. An ultrasonic domain voltage is impressed on a stator bonded with an elastic body and a piezoelectric ceramic is polarized in the direction of its thickness so that elongation and contraction would occur alternately when a voltage is impressed, to generate a refractive vibration on the elastic body surface.

The two electrodes of the piezoelectric ceramic are formed with a difference of 1/4th wavelength, so that when voltages of different phases (sine wave and cosine wave) are impressed, the waves generated on both electrodes are combined and a travelling wave occurs on the elastic body surface. When a rotor is pressurized and contacted with this surface by spring action, a rotary motion opposite to that of the travelling wave is generated by friction. Due to the pressurized contact, the output shaft is retained in its normal position when the motor is not actuated.

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97-08-002-05

Red Laser Recording Technology for Rewritable Phase-Changing PD Disc

Matsushita Electric Industrial Co., Ltd. has established a technology employing the 650-nm red laser beam used for digital video disk random access memories (DVD-RAMs) which enables the recording and playback of rewritable phase-change optical disks (PDs). The optical condition has been established that enables the PD disk to display the same recording and playback characteristics for both infrared and red beams, and the recording sensitivity has been confirmed to lie on the same level. The PD disk enables compatibility between the infrared laser recording and playback system and the red laser recording and playback system, so both a PD disk and a DVD disk can be used in a mix in the same recording and playback system.

The PD was commercialized in the spring of 1995 and is mounted not only in the company's personal computers but as well in those produced by Compac, IBM, NEC and Hitachi, and the company shipped out an aggregate of about one million drives and about 3 million disks. The company, based on the characteristic that the sector recording the PD disk data is designed with the same specifications as those of the hard disk (HD) and floppy disk (FD), had been striving to promote expanded application of the PD through compatibility with the DVD-RAM. Up till then, recording and playback with the PD was accomplished with a red laser beam of 795 nm.

Due to the establishment of the new technology, even if a shift was made to an age for large-capacity DVDs, PD users can continue to use PD disks and systems. The PD is a system that uses a rewritable phase-change optical disk with a capacity of 650 MB, and already about one million units of drive systems and about three million units of disks are active on the market. The company had been directing its attention on the characteristics of the PD disk not to rely much on the wavelength, and had been engaged in research to establish a technology that would enable the PD units to be utilized in the age of DVD.

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Machinery & Mechatronics

97-08-003-01

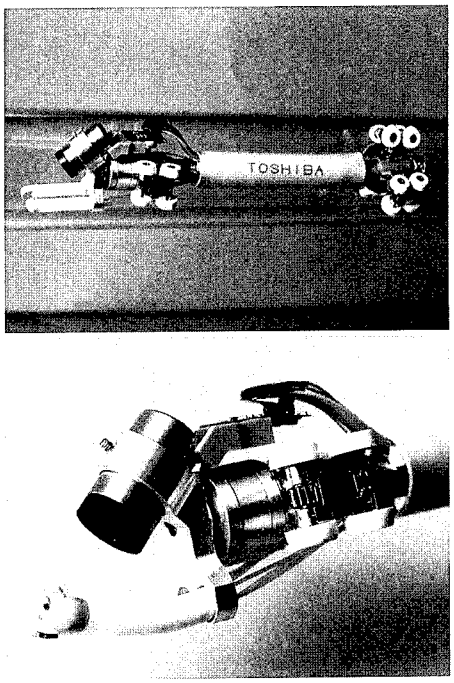
Robot for Working in Small-Diameter Piping

Toshiba Corp. has developed the world's first miniature inspection robot able to operate inside piping with a diameter as small as one inch. It can undertake visual inspections and identify and collect foreign objects.

The new robot provides an alternative method to conventional inspection of pipes with diameters of this size, which relies on complex and time-consuming disassembly. Despite extensive research into robots that can negotiate small-diameter pipes, it is the first capable of visual inspections and collection of foreign bodies.

The robot is 110mm long, with an external diameter of 23mm. It weighs 16g and can move at 6mm per second. Vision is provided by a compact 1/4-inch, 410,000-pixel camera mounted above its two-digit hand and a rubber flexible micro actuator (FMA). A synchronous motor drives a planetary wheel mechanism, controlled by planetary reduction gears and worm gears. Maneuvering is enhanced by a flexible rubber tube linking the front and back wheels that allows the robot to negotiate curves and bends.

Movement and operation are remotely controlled. The CCD and FMA hand movement are coordinated by wobble motor. A metal ring on the motor's drive shaft is covered with a wave generator, which is a rubber doughnut with six air chambers running along its length. Adjusting air pressure in these tubes changes the pressure exerted on the metal ring and the drive shaft, thus synchronizing CCD and



The world's first miniature inspection robot

FMA hand movement. Once the CCD identifies a foreign object, the operator can precisely control the FMA. Adjustment of air pressure in three compartments of each digit provides lateral and vertical movement and grip.

Multiple wheels in the planetary wheel mechanism are driven by planetary reduction gears and worm gears, which keep them pressed against the walls of the pipe. The planetary wheel mechanism assures the drive force required for controlled ascents and descents in vertical pipes.

The robot's capabilities make it ideal for industrial applications in such locations as electric power plants.

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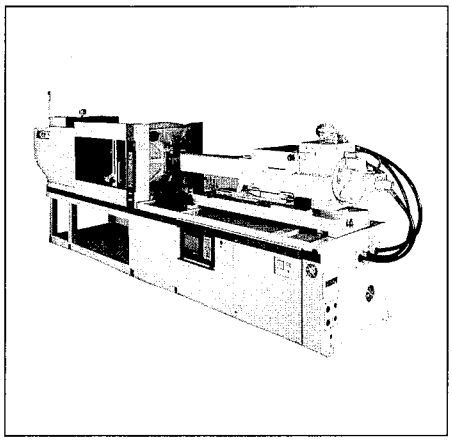
97-08-003-02

Injection Molding Machine with Telescopic Cylinder

Shinwa Seiki Co., Ltd. has marketed an injection molding machine available in the D Series that introduces a telescopic cylinder with a die that can be clamped with about one-third of the oil force required by conventional types of injection mold-



D Series

ing machines. The time required for die opening and closing as well as for die incremental clamping has also been shortened by about 20%. The machine is available in five models with die clamping forces of 30-190 t.

The D Series injection molding machines adopt the direct pressurizing die clamping mechanism. A small flow rate check valve is incorporated in a large flow rate check valve to increase the die opening and closing time, the tank installation spot has also been improved to shorten the oil shift distance, and the moldings can be taken out from three sides, or from the machine operating side, the non-operating side and the die clamping side.

Other advantages are that an air chamber installed inside the cylinder cools the die clamping unit, so that the oil temperature rise is suppressed to 35 °C after a lapse of 6 hrs, the power consumption rate has been reduced by 54%, and the noise has been reduced by a maximum of about 10 dB.

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97-08-003-03

Automatic Welding Carriage Specifically for Steel Reinforcing Cross Columns

Matsumoto Kikai Co., Ltd. and Tohoku Bridge Co., Ltd. have jointly developed an automatic welding carriage HASHIRA (Pillar) specifically for welding steel reinforcing cross columns in the process of constructing steel reinforced concrete buildings and structures.

The strain prevention band plate of the base metal of the cross columns that had been obstructing automatic welding has been replaced with a special-purpose jig, which made band plating unnecessary and greatly shortened the time for cross column assembling and welding. The welding carriage with torch was marketed in mid-June, 1997, and about 30 units of the automatic welding carriage will be sold monthly.

The welding carriage will be used in linkage with a CO_2 welding machine. After it is stabilized on the flange of the cross columns by magnetic action, it performs fillet welding of a T-beam at the web part of both sides of an I-beam under self-propulsion to produce cross columns about 8 meters long. Up till now, the welding was accomplished manually with a semi-automatic CO_2 welding machine, but automatic welding is now possible even in narrow places as long as there is a space of over 60 mm at the aperture parts of the cross columns. The automatic welding carriage is workable with cross columns of virtually all sizes, and even a non-skilled worker can perform excellent welding by manipulating 2-4 units of the automatic welding carriage. The automatic welding carriage is light and can be moved about manually.

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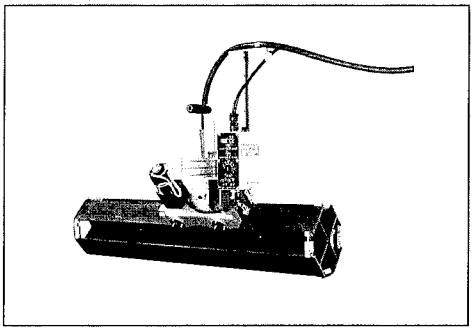
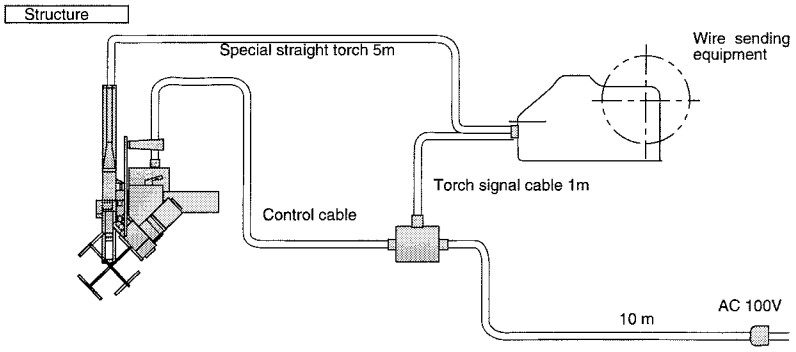


New automatic welding carriage



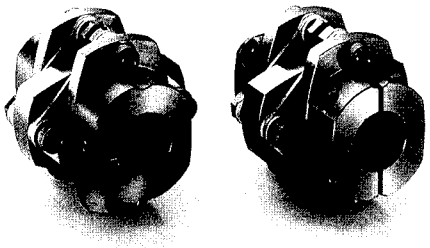
97-08-003-04
Leaf Spring Type Flexible Coupling

Sakai Manufacturing Co., Ltd. has commercialized and started accepting orders for a leaf spring type flexible coupling available in the "Sakai LC Series." These new leaf spring type couplings feature excellent structural rigidity, low inertial force and misalignment compensation.

The spring material at the axle clamping part does not undergo any deformation when clamping these couplings, while a unique structure is introduced for rotational positioning of the drive unit and for accurately transmitting the torque. For the bolt clamping system the double bolt clamping system is adopted that involves no centrifugal shaft whirring and whipping when clamping. High-precision leaf springs and set bolts enable precise positioning and uniform transmission. In addition, the hubs and spacers are designed with low inertial force for retaining their strengths stubbornly, and the influence of air resistance at time of high-speed revolution has been suppressed.

In particular, the coupling's rigidity has been increased by 1.5 to 2.0 times compared with conventional types. They also feature a compact design that makes them lightweight with low inertial force, while their backlash-free structure enables accurate positioning.

These couplings are available in eight types with hub outside diameters of 45-155 mm, and are being sold at domestic prices of from ¥7,520 to ¥41,360.



Sakai LC Series

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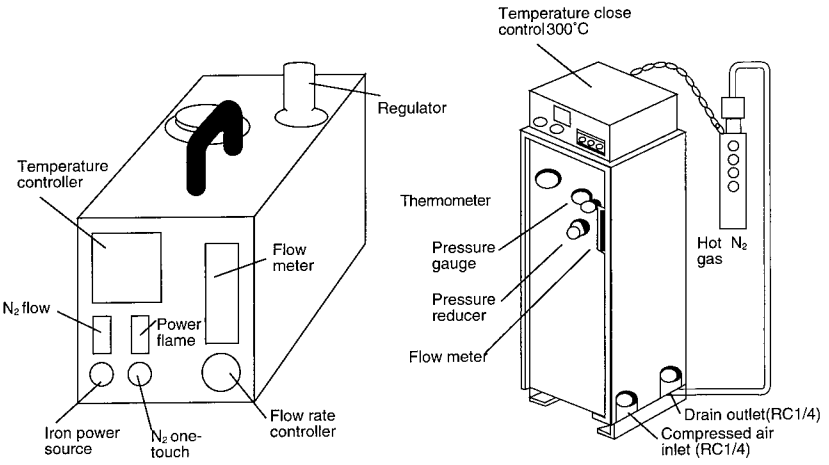
97-08-003-05
Soldering Iron Uses Nitrogen Gas

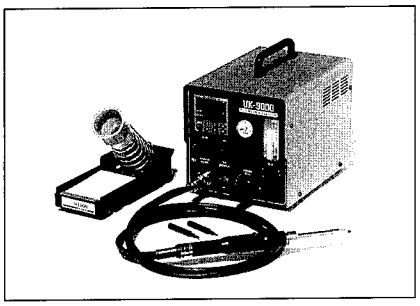
Taisei Kaken Co., Ltd. has introduced on the market a new type of soldering iron J-MAX® UK-9000 SW that is worked in conjunction with a nitrogen gas generator and the soldering tip temperature is retained with heated nitrogen gas. This is the first soldering iron operating with nitrogen gas.

With UK-9000 SW, the nitrogen gas is passed inside the soldering iron heated to 120-180 °C with a heater, then jetted out from the tip of the soldering iron. Therefore, the tip temperature is retained with nitrogen gas and little lowered when soldering. As a result, soldering is possible in a wide temperature range from the low-temperature domain (250-280 °C) to the high-temperature domain (350-420 °C).

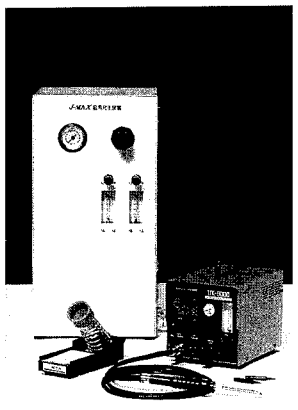
The hot nitrogen gas is pressurized to 0.1-3.0 kg/cm^2 and heated to 120-180 °C preventing solder oxidation, and the preheating effect almost completely prevents the generation of bridges, solder holes and other defects. The deoxidation effect of the pressurized hot nitrogen gas prevents flux generation, and the degassing effect provides welds of superfine crystals free of porosity and segregation. The temperature recovery characteristic is also excellent, and the service life of the soldering iron prolonged by 5-10 times compared with using the soldering iron in the atmosphere without nitrogen gas shielding.

The preheating effect with hot gas prevents the generation of soldering defects, making the soldering iron using nitrogen gas ideal for soldering surface decorative parts in dense, fine pitches. The soldering iron is marketed at a domestic price of ¥200,000, and the nitrogen gas generator at a price of ¥1-2 million depending on its specifications, and that can be used in combination with a equipment produced by other manufacturers.





J-MAX UK-9000



Nitrogen gas generator

* *Taisei Kaken Co., Ltd.*
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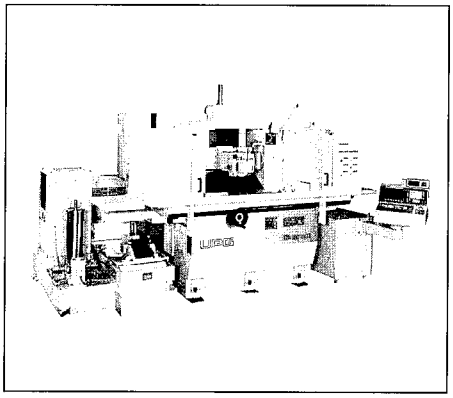
97-08-003-06

CNC Ultra Precision Surface Grinder

Okamoto Machine Tool Works, Ltd. has put on the market a CNC Ultra Precision Surface Grinder UPG-63NC that enables both surface and form grinding. The grinder is equipped with a swing-type dresser of minimal forming limitations for a grinding wheel, and the grinding conditions can be set automatically by computerized numerical control (CNC) and graphical conversational type software.

UPG-63NC is a surface grinder capable of mirror-like surface grinding as well as



UPG-63NC

ultra precision form grinding. Grinding wheel spindle run-out is minimized with non-contact oil static pressure bearings, while all the guideways in longitudinal, cross and vertical directions are also incorporated with an oil-static pressure mechanism to ensure minute feed accuracy and straightness. The cross and vertical feeds can be set to minimum increments of 0.0001 mm under a closed loop system to permit highly accurate positioning. Grinding wheel forming and contour grinding can be done by simultaneous 2-axis control.

In addition, a water-cooled fully sealed motor for the wheel spindle developed independently by the company features less heating, and the hydraulic and static oil temperatures are regulated automatically with a tolerance of ±0.2 °C. The NC-type swing type dresser avoids interference with the grinding wheel. A permanent electromagnetic-type chuck is employed as the workpiece mount datum, which is free from heating and maintains dimensional accuracy over long periods of time.

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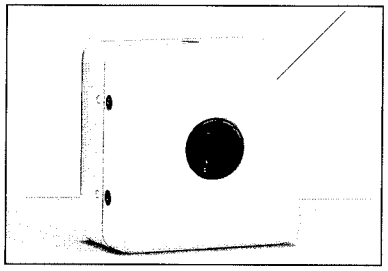
Information & Communications

97-08-004-01

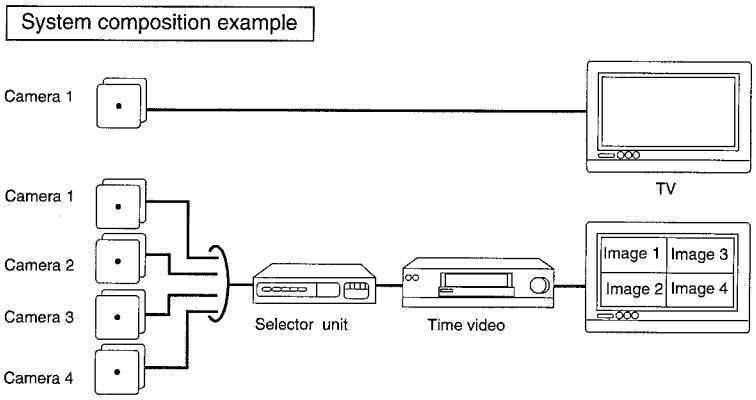
Supercompact Charge-Coupled Device Color Camera

Arc Intention Community Co., Ltd. has started marketing a newly developed telescopic type compact charge-coupled device (CCD) color camera "Ai Shi Kyachi". Conventional types of cameras using image pickup tubes are associated with problems such as the generation of residual image and seizure, but the use of the CCD eliminates these problems. In addition, the photographed images are much more clear. The camera is usable in a magnetic field, is highly resistant to vibrations, there is no image distortion, the power consumption is extremely low, and there is the added advantage that the camera features a long service life and excellent characteristics.

Compared with standard types of cameras, it is ideal for taking photographs from a distance, which alleviates the individual discomfort and sense of



Supercompact CCD color camera



oppression of being watched. The new camera enables photography from a pinhole with a diameter of 1 mm, making it ideal for use as a crime prevention camera. It is supercompact with a size of 58 mm × 58 mm × 32 mm and can therefore be incorporated snugly into various types of equipment. It features a wide visual image angle of 93 degrees, and the faces and actions of the target can be confirmed even if pictures are taken in a dark environment with an illumination of 2-5 lux.

The camera is sold at a domestic price of ¥135,000. It is a power conservation type with an electric cost of only ¥20-30 even when used continuously for a month.

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97-08-004-02

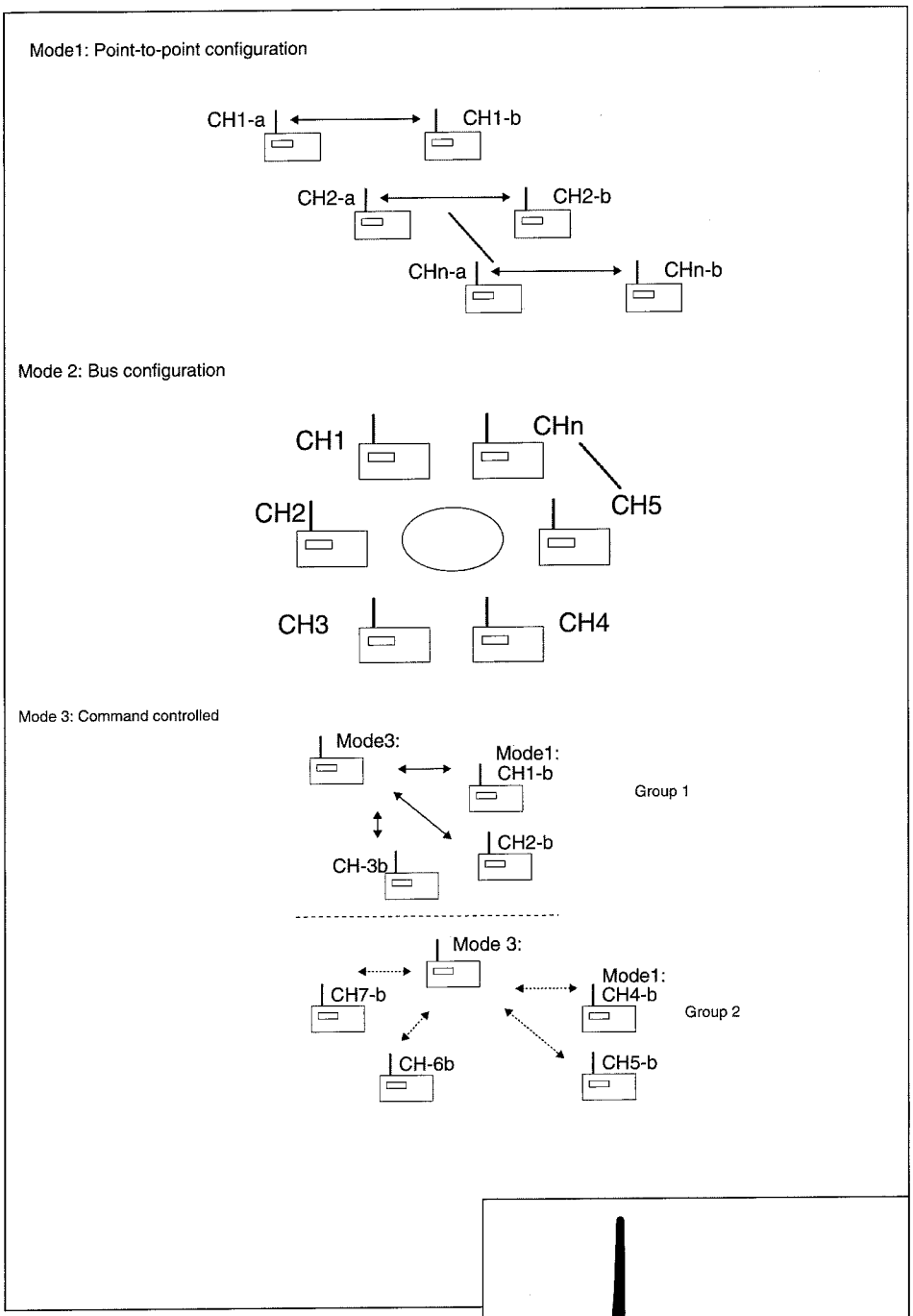
New 2.4Ghz Spread Spectrum Data Transceiver

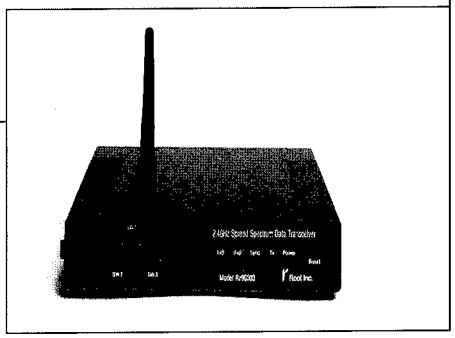
ROOT INC. has introduced the Rz96003 2.4GHz ISM band spread spectrum multiplexed wireless modem. It uses direct sequence spread spectrum technology in the RF section, enabling a transmission rate of up to 2 megabits per second. Each modem has one RS-232 (EIA-232) digital port which provides the user with a fixed bit-rate data communications interface.

In addition, 57.6 kbps of continuous data can be transferred each direction simultaneously when used in the configuration utilizing eight full-duplex channels. The modem can also be configured for 13 full-duplex channels at 38.4 kbps or 16 channels at 19.2 kbps. Other user-selectable communication modes include multidrop for up to 32 recipients, relay mode and command mode.

Rz96003 communication rages are up to 1/8 mile indoors and 1 mile outdoors. These ranges can be extended using the modem in relay mode, providing a low-cost wireless Intranet application.

The company, which comprises a group of engineers with extensive backgrounds in communications and digital design technology, was founded in 1993. ROOT has completed many RF and digital communications system designs for such major companies as AOR, Sharp, Sony and Pioneer. Hiroshi Mano, president, describes the new product as a "user-friendly, self-contained, spread spectrum modem that provides superior performance to industry for remote data acquisition and processing where accuracy and security are important." Deliveries of this product, which is "well suited to those customers requiring fast data transfer using the latest in spread spectrum technology," began in June at less than US$1,000.





Rz96003

* ***ROOT INC.***
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97-08-004-03

High-Speed Three-Dimensional Object Data Input and Modeling System

Minolta Co., Ltd. has developed a High-Speed 3D Digitizer Modeling System that converts the features of solid objects into three-dimensional data and recreates these objects by referring to these data.

This system performs high-speed photography of the target object and instantaneously captures 40,000 points (vertical 200 × horizontal 200) of three-dimensional digital data of the object in as little as 0.6 s. Shape input is performed by the principle of operating a camera, so the time normally required for modeling is reduced considerably, and data processing performed with ease with a personal computer. With a facial output, for example, the face can be carved out and fabricated in about 3 min.

Several conventional types of shaping systems are available which perform shape cutting by using a digital camera and a scanner, but since these systems normally work with two-dimensional images, modeling with these image data is quite cumbersome. In addition, intricate processing will be involved if these modeling data are transformed into machining data in the process of shaping, and the cutting and shaping time would require much time.

The new shaping system is a unique system that resolves all these problems and enables the modeling, data processing and cutting operations to be performed continuously at the spot where the target object is photographed. The system has various applications, such as the fabrication of models for design studies within a corporation, as well as the experimental fabrication of temporary mold in an industrial plant.

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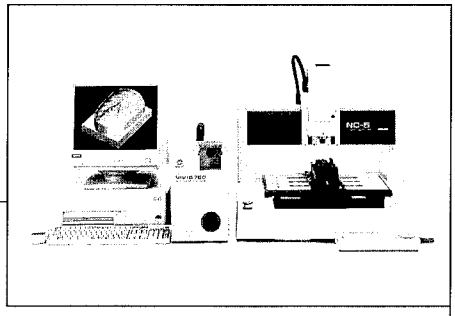
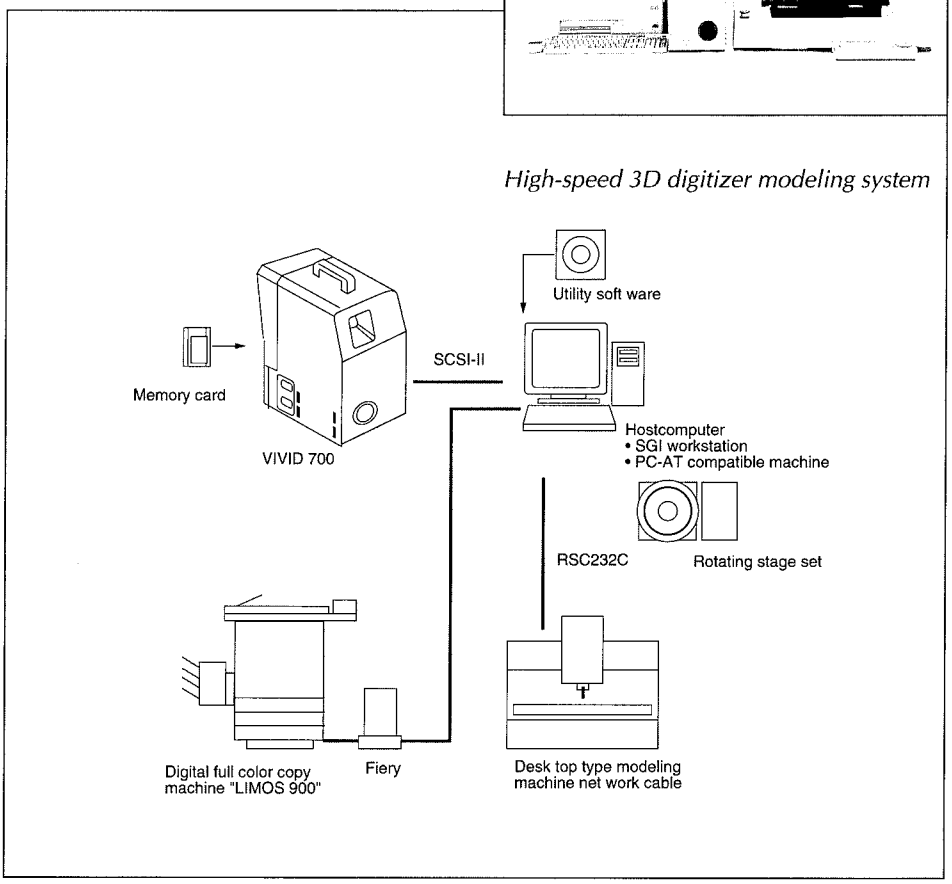


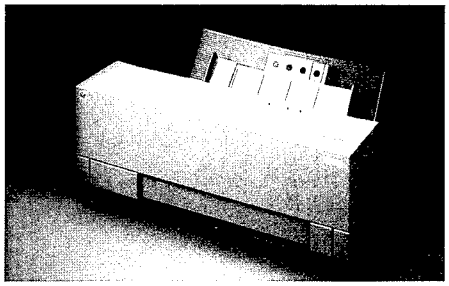
High-speed 3D digitizer modeling system



97-08-004-04

Thermal Transfer Printer

Alps Electric Co., Ltd. has developed a new model of a thermal transfer Micro Dry™ Printer that features the highest level of image resolution, and started marketing from June this year the Model MD1000-J version for Windows operating system and the Model MD1000-D version compatible with Windows and Macintosh operating systems.



MD-1000J/D

Models MD-1000J/D feature a smaller dot diameter than before due to the establishment of a new heat control technology which enables much smoother resolution of color graduations. As a result, full color printing in 1,200 dpi × 600 dpi on an exclusive glossy paper is now possible for the realization of much finer image representation comparable to that of photoprinting. Also, a newly marketed glossy ink enables full color printing with excellent gloss, like the surface of a photograph in 600 dpi × 600 dpi. Further, using a new unique white ink enables white color printing that had been impossible with conventional types of full-color printers.

An original mounting technology is introduced that permits the printer to be designed compact and lightweight, and the printer is marketed in several body colors to match the printer to the home. The MD1000-J model is marketed at a domestic price of ¥44,800, and the MD1000-D model at a price of ¥49,800. The company anticipates to sell one million units of MD Series printers.

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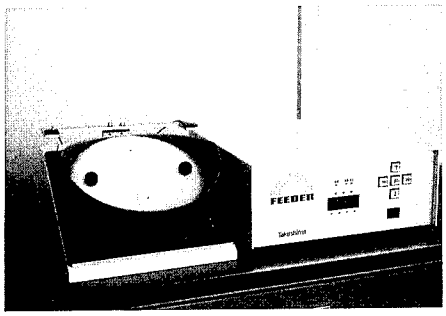
Process & Production Engineering

97-08-005-01
Precision Parts Supply System for Manufacture of Diverse Products in Small Lots

Takashima Sangyo Corp. has started accepting purchase orders for a newly commercialized precision parts supplier "Disk Feeder" that responds to the needs to manufacture diverse products in small lots.



Disk Feeder

A disk with neatly arranged holes on its circumference is revolved while vibrating it inside an inclined parts bowl, and the parts extracted from the upper part. Data relating to the optimum shapes of neatly aligned holes as well as in connection with vibration and feed speed control have been collected through actual production lines depending on the sizes and shapes of the parts. Based on the wonderful performance of this precision parts supply system, the company has ventured to sell its products on the general market for the first time. Incidentally, patent rights are pending for the system.

The parts bowl's angle of installation is determined by vibrating and revolving the disk with holes opened and feeding the parts from the bowl's upper part. The system is ideal for use in the manufacture of diverse parts in small lots, simply by changing the disk. The vibration and speed can be set appropriately by changing their setting values, and the system can be linked to outside systems by matching the input/output signals. The system is being sold at a domestic price of ¥500,000-600,000 depending on the specifications. The disk feeder was developed about a year ago for its own use by the company that is assembling precision systems and equipment, and the disk is being sold for about ¥30,000 apiece.

The parts bowl's installation angle is 30 degrees, and the resin disk has a diameter of 200 mm. By using a stepping motor and a timing belt in combination, the vibrations and a fixed degree of phase shift are controlled accurately while repeating the disk's forward and reverse revolutions. Parts with lengths of up to roughly 25 mm can be corresponded, and various types of parts can be corresponded simply by changing the disk. Also, an infrared ray sensor is fitted as a standard accessory on the upper part of the system to judge the state of arrangement of the parts, and in case of any faulty parts arrangement, the parts bowl is dropped.

The new system is available at a lower capital investment than for conventional types of parts feeders, while the changing of product is also possible at a low cost simply by changing the disk, so the system's total cost is reduced considerably.

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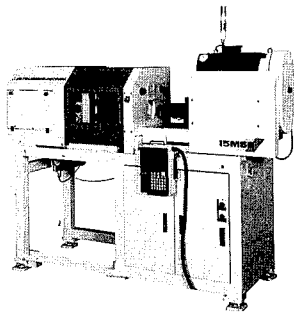
97-08-005-02
Motor-Driven Injection Molding Machine

Mitsubishi Heavy Industries, Ltd. has developed a compact motor-driven injection molding machine available in three models which can mold engineering plastics and enable superprecision molding with great stability.

The company previously manufactured injection molding machines with die clamping forces of 80-5,000 t, and has now ventured into the sector of compact machines with clamping forces of 15-50 t, of which the model of 15 t is available at a domestic price of ¥5,500,000.



Compact motor-driven injection molding machine

The brand name is Mitsubishi-Hotsuma Injection Molding Machines, and the 15-t version is called Model 15 MSE, the 30-t version Model 30 MSE and the 50-t version Model 50 MSE. These machines introduce the spiral screw featuring excellent resin meshing and feed attributes to enable uniform plasticizing. They can work with both versatile type resins and engineering plastics which are normally difficult to mold.

Compared with conventional machines using the in-line type screw, the screws of these new injection molding machines revolve at fixed positions during plasticizing, so the resins are heated uniformly. The key to precision molding lies in the raw material accurate filling, and in this respect the new machines feature excellent control of resin pressure inside the cylinders due to closed loop control based on the use of an AC servo motor and a load cell provided at the bottom of the plunger, so that the resin pressure is sensed constantly to enable scaling at a fixed volume to permit precision resin filling. In addition, the power consumption is about one-third that of the conventional type of hydraulic machines, and cooling water for oil cooler and a cooling tower is not needed.

The company has no plan for overseas sales of the MSE series for some time.

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97-08-005-03
Pure Cotton Stretch-Processed Fabric

Kanebo Spinning Corp. has developed its first product, a pure cotton stretch-processed fabric TECHNO FIT.

TECHNO FIT is stretched and contracted flexibly by a special textile finishing technology for weaving the warp and woof loosely and giving stability to the fabric. The fabric has an elongation of 10-20%, features an excellent body fit, sense of comfort and does not become elongated with continued use like ordinary 100% cotton fabrics. In addition, the stretch is not deteriorated even when the material is laundered or ironed. Fabric production will be started as early as within the year.

Weaving a flexible stretch fabric simply by using cotton yarn, without adding any synthetic chemical fiber, is quite rare. The fabric can be woven with conventional types of production facilities employed for working with pure cotton fabrics, and can also be used with other types process of functions such as water repellency, shape stability, sterilization and odor suppression. The new fabric will be marketed for use in the manufacture of women's blouses and coats, and for producing shirts.

This product is also to be manufactured by the company within the year at its Nagahama Plant.

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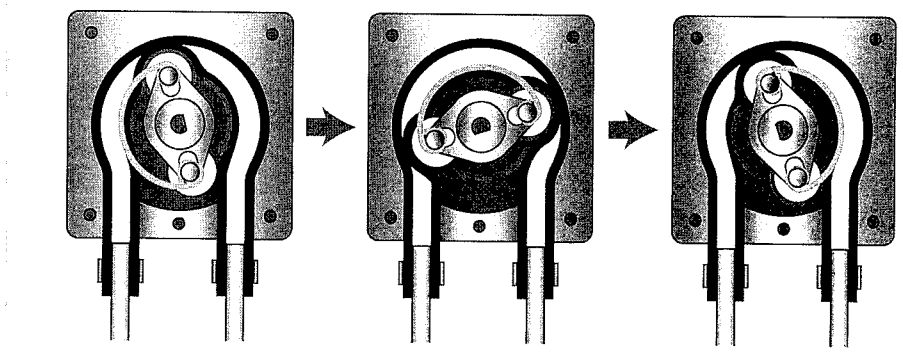
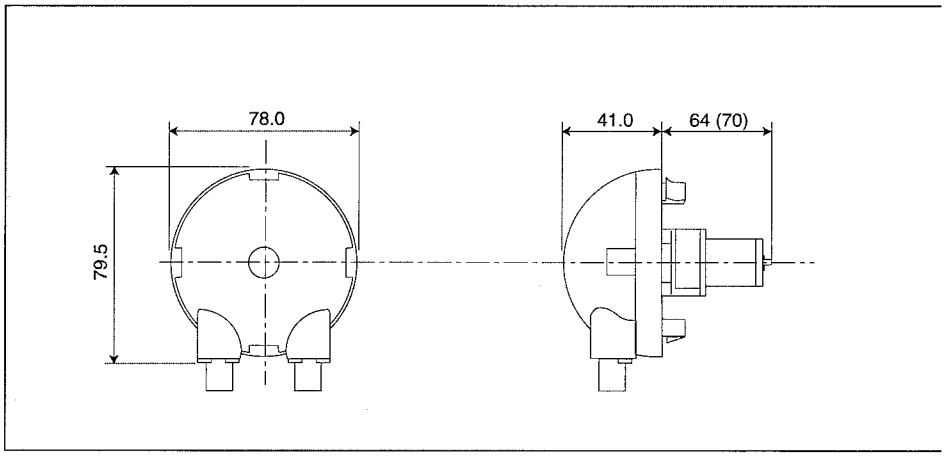


Principle of the Tube Pump
The two rollers fitted on the rotor are rolled along the tube in concert with the rotor's revolution. The tube is fully compressed with this roller mechanism, and the liquid inside the tube pushed out and dischared forcibly. New liquid is sucked into the tube with the vacuum generated by the tube's force of restitution.



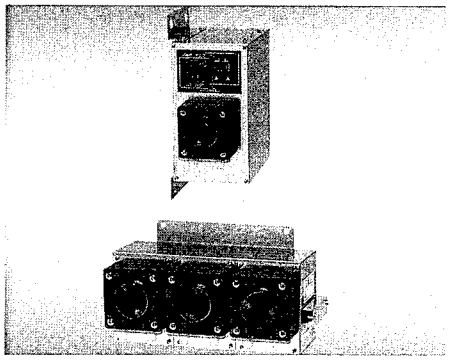
Outside dimension

97-08-005-04
High-Performance Tube Pump

Welco Co., Ltd. started selling from June this year a compact tube pump available in the WP1000 Series for transferring all kinds of liquids including chemical reagents. These tube pumps are additions to the family of Pulser pumps the company is already marketing and come in five models with a broad range of exhaust volumes of 0.5-220 cm^3/min and three types of tube. These tube pumps are designed for incorporation into all kinds of equipment and machines including medical equipment, washing machines, food processing machines and printing machines.

With these tube pumps, a pair of rollers fitted on the rotor moves along the tube, and when the rotor revolves, the tube is completely compressed with the rollers to push out and discharge the liquid inside the tube forcibly. Liquid is sucked inside the tube by the regenerative force of the compressed tube. These tube pumps can operate with liquids which are highly viscous or contain slurry, there is no fear of problems even when run idle, and there is no need for any priming water.

The WP1000 Series tube pumps were developed especially for use as compact types for medical purposes and for analysis. The tubes are durable types developed by the company and resistant to various types of liquids including strong acidic and alkaline liquids. The pump structure, designed for maintenance ease and low cost, enables them to be fitted on or replaced with ease with a simple coupling method. The simple bayonet coupling method is adopted for mounting and removing the pump part and base part, and the base part adopts the one-touch method enabling snap action mounting. Also, the entire pump assembly is made of transparent plastic to enable operations to be observed at a glance, and to allow visual checking with ease.



WP1000 Series

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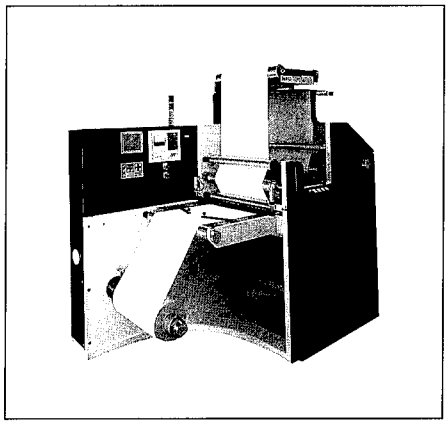
97-08-005-05

Paper Conservation Type Winder for Leftover Labeling and Business Form Paper Rolls

Mashintex, Ltd. has marketed a paper conservation type winder Windmax for winding up labeling and business form paper remaining on rolls. The paper remaining on rolls after printing is connected with a tape and rewound on a roll to enable paper conservation and reuse. The winder, together with its software, is sold at a domestic price of ¥5,800,000.



Windmax

The label and business form printing trade stores in warehouses or disposes of the paper remaining on rolls subsequent to printing, which is a tremendous loss. Wind Max links Machine Techs Co.'s drive technology with a tension control technology belonging to Cleveland Motion Control, Inc. (U.S.) and a web running control technology belonging to BST Servo-Technik GmbH (Germany). It can store in its memory various data such as the distance between joined paper parts, the total length of the paper wound on the roll and the paper windup tension, in connection with up to eight rolls.

Paper joining is performed quickly and accurately since the paper joining pedestal not only applies the tape on the web surface but also on the web rear side. The knife holder incorporates a blade angle fine adjustment mechanism that enables both trimming and half-cutting to be accomplished under optimum conditions. By linking the system to a Windows 95 personal computer, any number of rewinding rolls can be controlled. The web running distance, windup diameter and other data are sensed automatically and shown on the touch screen, and by linking the system to an external computer, it is possible to input and control data relating to eight rolls, such as the paper running distance between joined parts as well as the web width.

The line speed is maximum 140 m/min, the maximum feed paper diameter 650 mm, the maximum windup diameter 700 mm and maximum web width 470 mm. The winder system has a width of 1,750 mm, depth of 960 mm, height of 1,700 mm and weighs about 1,600 kg.

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97-08-005-06

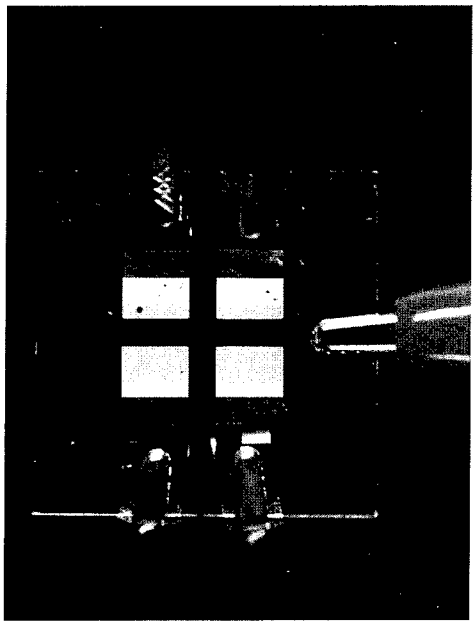
Multicolor Organic EL Devices with Organic Dyes Dispersed in a Single Polymer Layer

Assoc. Prof. J. Kido and a research team at the Graduate School of Engineering of Yamagata University have developed a simple inexpensive process of fabricating multicolor electroluminescent (EL) devices.

EL materials glow by themselves when powered even with a low voltage, and thus work without backlighting. EL flat panels promise to be the mainstream in the next generation of displays for computer systems (especially mobile computers) if a full-color version is produced at a modest cost. Researchers worldwide are now developing inexpensive EL devices emitting the three primary colors (red, green, and blue).

A conventional full-color EL display has been proposed with white light emitter and different color filters. Another uses a blue emitter and fluorescent color conversion layers. The production processes involve many steps, and thus take much time and money.

The new device has a pair of electrodes and a single intervening EL layer with dispersed organic dyes. The dyes are bleached by ultraviolet radiation differently from point to point so that the device sheds more than one color light. The process requires little more processing than a monochrome device. The cost will be much less than that of the conventional approaches to multicolor devices.



Multicolor organic EL Devices

The research team made a prototype 5×5 mm^2 device emitting blue, yellow and white light. The prototype is made of a transparent anode on a glass substrate, and a 100-nm overlay of an EL material doped with organic blue and yellow dyes. Before covering with a cathode, the EL layer is subjected to photolithographic treatment with a mercury lamp. Because the yellow dye is vulnerable to ultraviolet, the color fades away depending on the quantity of irradiation. The masked part prevents any effect on yellow, and thus the emitted light is yellow. In areas where yellow is faded off by ultraviolet irradiation, blue light is emitted. White light is achieved by a mixture of blue and yellow light where the yellow dye is partly faded. Another prototype was fabricated to emit yellow and green.

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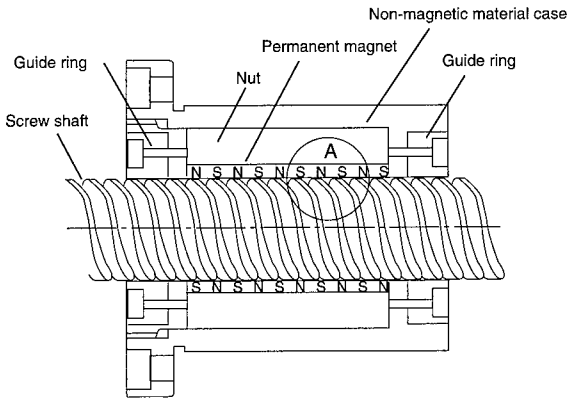
Construction & Transportation

97-08-006-01

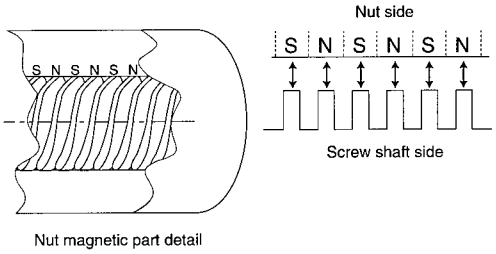
Conveyance Unit Using Magnetic Screw

Koyo Machine Industries Co., Ltd. has started marketing a conveyance unit that uses a magnetic screw utilizing the magnetic force provided by a permanent magnet. In contrast with the ball screw using steel balls, the magnetic screw revolves by non-contact and requires no lubrication, so features excellent cleanliness and low noise, and since the screw shafts are linked in multiplex, long strokes are available which cannot be provided by ball screws.

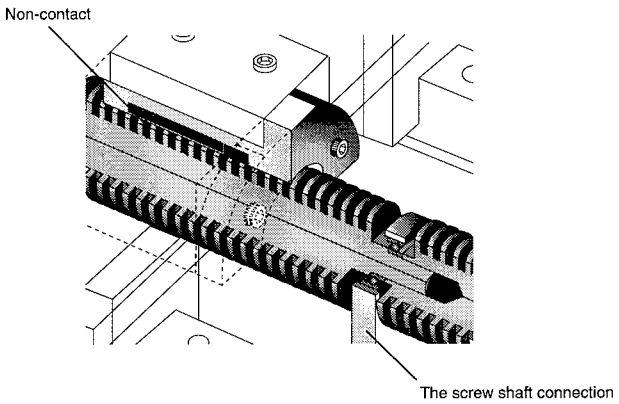
The magnetic screw is fitted magnetically on the inside of a magnetic nut and displays its screw function by utilizing the attracting forces of the N and S poles generated between it and the screw shaft. The outstanding features are simple construction, non-contact operation, no lubrication, low noise, no dust generation, long-term maintenance-free operation, semipermanent service life and torque limiting effect (load limiting effect).



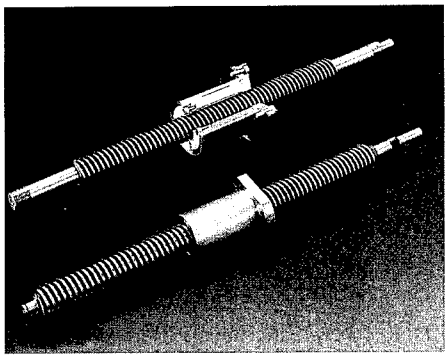
Device and construction drawing



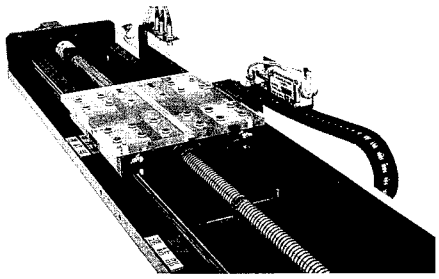
Part detail



Construction drawing



Magnetic screw



Conveyance unit that uses a magnetic screw

A half nut is used in combination with this magnetic screw, and the unit is magnetized in spiral shape. Due to the half nut shape, these magnetic screw units can pass through the support mechanism even if these screws are linked in multiplex to enable the realization of long strokes.

The new conveyance unit using magnetic screws is ideal for use in the process of manufacturing semiconductors, and is marketed at a domestic price of about ¥2 million. The screw itself is also available. In the process of conveyance of semiconductor wafers, for example, there is the process of alternately conveying these wafers through the vacuum domain and the atmospheric domain, so by using this unit, it will be possible to install a shielding plate at the linkage part.

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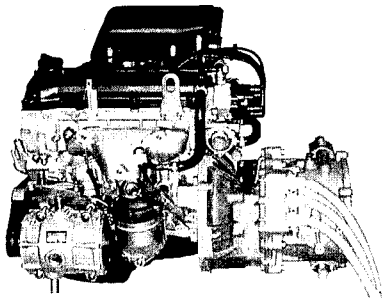
97-08-006-02
Hybrid Electric Vehicle

Nissan Motor Co., Ltd. has developed a hybrid electric vehicle (HEV) that combines the clean, zero-emission benefit of an electric vehicle with the versatile convenience of a gasoline-engine vehicle.

The HEV is equipped with a propulsion system that combines an electric motor with a gasoline engine. It is designed as a series HEV in which the gasoline engine powers a generator to produce electricity for running a traction motor that drives the wheels. With this system, the engine is only used to drive the generator at a low, efficient speed. Because the wheels are driven only by the traction motor, the vehicle can be operated as a pure electric vehicle with the engine shut off to provide a driving range of approximately 50 km on a full battery charge. For instance, the vehicle can be drive as an electric car in the city and as a hybrid vehicle on the open road.

The adoption of this hybrid propulsion system with the engine only used to drive the generator at a low speed, makes it possible to extend the driving range substantially by approximately 2 times over that of a gasoline engine vehicle. Exhaust emissions are also dramatically reduced, with CO_2 emissions lowered by approximately 50% and NOx, HC and CO levels by approximately 95%. Moreover, driving in the EV mode provides the zero-emission performance of an electric vehicle.



Hybrid system

Hybrid electric vehicle (HEV)

High power-density lithium-ion batteries will be adopted which are designed especially for use on a hybrid vehicle. These batteries are based on the lithium-ion batteries used on the Nissan Prairie Joy EV, and feature improved electrode materials and structural modifications which will increase their power density by approximately threefold. As a result, the onboard battery size can be reduced by about two-thirds compared with that of conventional lithium-ion batteries. Along with reducing the vehicle weight, this will also result in improved use of space.

A 1.3-liter gasoline engine is used to drive the generator at a low speed of approximately 2000rpm. Because the wheels are driven by the traction motor, quiet, smooth operation resembling that of an electric vehicle is achieved.

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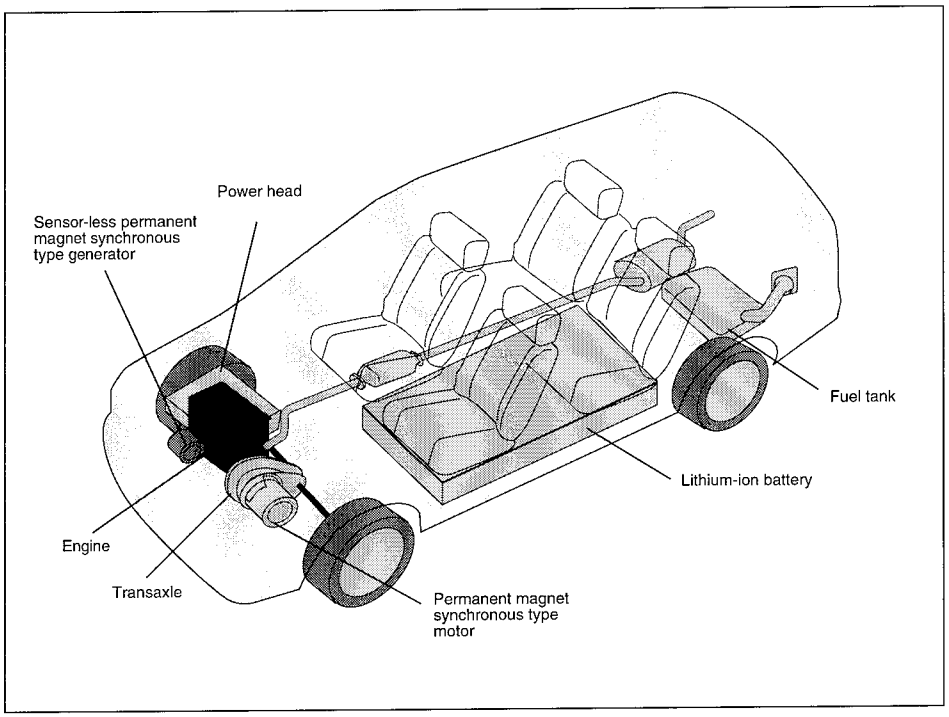
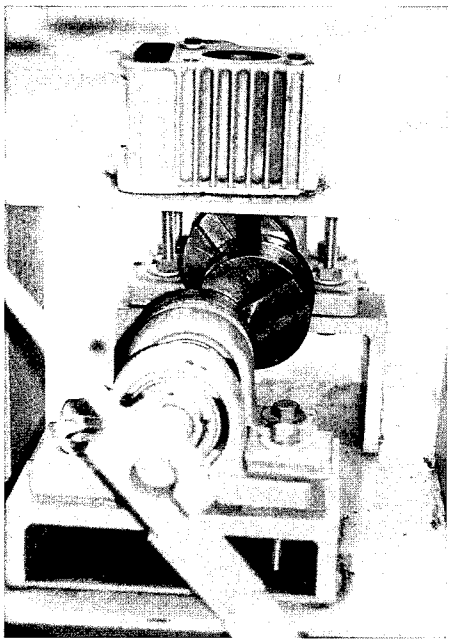


System chart

97-08-006-03
Oldham Type Crank Engine

Yonehara Giken Co., Ltd. has acquired patent rights in the United States and Japan for a newly developed "Oldham Type Crank Engine." With the conventional type of piston engine, the inside cylinder pressure attains its maximum value when the piston in the top dead center is exploded as observed from combustion dynamics, and the pressure decreases rapidly directly after the piston starts moving after the fuel explosion.

However, when the piston lies in its top dead center position, the piston rod and the crank arm assume the state of being linked directly on the line of center of the cylinder axis, with the result that, in this state, it will be impossible structurally for the piston rod's pushout energy to be converted into the crank arm's rotary energy. To complement this disadvantage, a flywheel is fitted on the crank shaft side, but there is no change in the fact that the energy transmission efficiency at time of maximum explosion pressure directly after the fuel explosion is extremely poor. The Oldham drive crank engine was developed this time to resolve this problem, and is designed to extract the maximum combustion pressure at near the piston's top dead center for use by the output shaft most effectively.



Oldham Type Crank Engine

A unique construction is introduced that utilizes a pair of sliding flanges, by which the main characteristic is that the efficiency is increased to over double that of the conventional type of crank engine. The company plans to commercialize the engine in tie-up with engine manufacturers.

The engine applies the mechanism of the Oldham joint and adopts the mechanism of using a connecting rod to sandwich the disk that changes the piston's vertical motions into rotary motion with a pair of flanges. The disk side is convex and the flange side concave, and the flanges are slid in conformance the disk's rotation.

The basic principle of this mechanism is that the sliding creates a displacement in the lines of centers of the pair of flanges, with the result that the maximum pressure can be extracted most efficiency directly after fuel explosion, which had been difficult with the conventional type of crank engine. According to the company, a high efficiency of 2.7 times is featured compared with the conventional type of crank, and that the efficiency is over double even when the resistance loss of the sliding part was deducted, which translates into energy conservation as well as engine downsizing and weight reduction. Incidentally, the company has also applied for patent rights in Europe and in Korea, in addition to the acquisition of patent rights in the United States and Japan.

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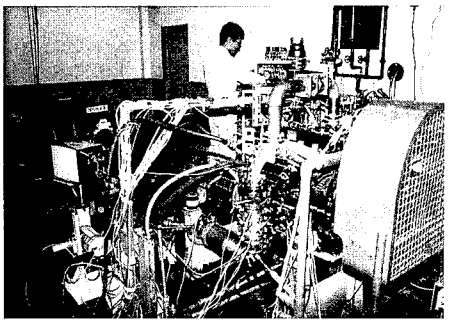
97-08-006-04

NOx Emissions from Methanol Fueled Vehicles Reduced to One-Tenth

The Traffic Safety and Nuisance Research Institute, Ministry of Transport has developed a technology to reduce to one-tenth the nitrogen oxides (NOx) emitted by methanol vehicles which are low emission, alternative vehicles. The technology is expected to improve the performance of direct fuel injection methanol engines in which the fuel is injected directly into the combustion chamber. Improving the state of fuel combustion in the engine has improved the thermal efficiency of the methanol engines to the same level as that of the direct fuel injection diesel engine.

This new technology consists of reducing the NOx emissions and improving the engine thermal efficiency. NOx emissions are reduced by returning a part of the exhaust gas to the engine inlet port by an exhaust gas recirculation (EGR) technique that is an effective method for decreasing the NOx emissions. The exhaust gas is returned by 45% at low load and by 20% at high load. Meanwhile, to improve the thermal efficiency, the intake air is heated during low loads and supercharging is performed with an intercooler at high loads.

Introducing these techniques for vaporizing the methanol injected into the cylinder and improving the vaporized methanol mixing with air will improve the fuel combustion efficiency. The hydrocarbons (HC) and carbon monoxide (CO) emissions are reduced considerably. Introducing these thermal efficiency improvement technologies has enabled heavy exhaust gas recirculation (EGR), a low-NOx combustion technology, for the first time over the wide engine load range from idling to full-load operating. To achieve both thermal efficiency improvement and NOx reduction at a high level, experiments were conducted to optimize the intake air temperature, boost pressure and EGR rate. As a result, a high thermal efficiency (23-38%) comparable to that of a direct fuel injection diesel engine was obtained over a wide range of engine loads.



High-efficiency, low NOx methanol engine system

A direct fuel injection type engine of 3,260 cm^3 displacement for 2-ton trucks was used in experiments operating the vehicle at a steady speed of about 40 km/hr (engine speed of 1,500 rpm), over which case the NOx emission were reduced to one-tenth in wide engine load conditions. By operating a 1.kW engine continuously for 1 hr, the NOx emissions were 1 g, much lower than the 4.5 g permissible limit prescribed for heavy-duty diesel engines by a law that becomes effective in 1998. The engine thermal efficiency was also improved by a maximum of 8% with respect to conventional types of methanol engines, or to the same level as that of the direct fuel injection diesel engine.

The experiments were conducted by operating the engines at a contact engine speed, so experiments will be conducted further under real driving conditions of acceleration and deceleration the engine speed, in which case the engine is expected to display results which lie below the permissible emission limits.

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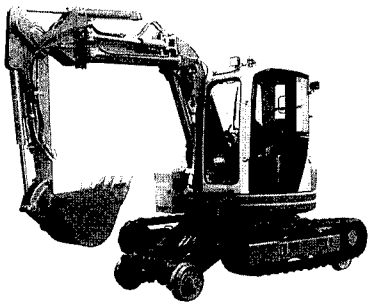
97-08-006-05

Combination Road/Rail Repair Machine for Railway Maintenance

Komatsu Ltd. has marketed for railway companies a new model of a combination road/rail repair machine Super Liner PC50UUT with bucket capacity of 0.2 m^3.

The machine is designed for railway maintenance work including ballast scattering.

The self-lifting capacity has been increased by 1.5 times compared with previous models to enable the truck to be lifted on or off the rails with ease, and the truck can also be used on both wide- and narrow-gauge tracks without grounding over the rail with great stability. The braking mechanism adopts the bothway blade lever type enabling use with ease. The frame distance between axles has been shortened to enable operations in reach to be performed with easily as well as improve the riding comfort. An auxiliary engine is mounted to enable the repair truck to return to the depot or escape the main track in the event some problem occurs with the main engine.



Super Liner PC50UUT

In addition, a hydraulic motor lock brake as well as a disk brake are mounted for safe and reliable wheel braking, and various other advanced systems are introduced such as an automatic height adjustment system. The truck is marketed at a domestic price of ¥16,950,000.

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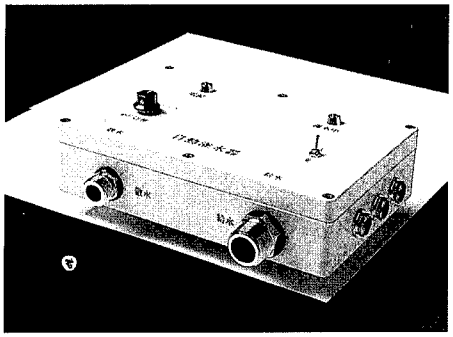
97-08-006-06

Irrigation Indicator Automates Water Spraying

Sanwa Electric Co., Ltd. has marketed an irrigation indicator Water Kure (Give Me Water) Sensor that is designed to spray water automatically on farm crops. The indicator senses the state of soil drying and whenever the dryness attains a prescribed level, an indicator lamp is lit to instruct water spraying. It enables conservation-oriented water spraying in hothouse cultivation, in home gardening, also on farm crops and golf courses. The indication system is marketed at a domestic price from ¥30,000 to ¥50,000 depending on its specifications.

The sensor unit, a hygroscopic element, is a gypsum block with a diameter of 18 mm and 38 mm long, and is implanted with a pair of electrodes. By establishing an ideal blend between the gypsum powder and water, it is possible to produce indicators of uniform performance. The state of soil dryness is measured not by the degree of water content but rather by measuring the moisture tensile force, and the state of dryness sensed from the changes in the electrical resistance of a hygroscopic element, so there is no need to supply water when applying the tension meter system. The unit is not influenced by the water retention that differs with the specific type of soil, and can make measurements very accurately by reacting most sensitively even to weak moisture tensile forces.



Irrigation indicator Water Kure (Give Me Water) Sensor

The irrigation indicator is adopted in two kinds, one for measuring low moisture tensile forces and the other for measuring high moisture tensile forces. A type that enables adjustment of the moisture tensile force is also available.

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Energy & Resources

97-08-007-01

New Type of Wire Diameter Gauge Using Laser Beam

Anritsu Corp. has developed a Scanning Laser Beam (SLB) Din Measuring System that is usable in all kinds of environments and available at a very competitive price.

A unique structure is adopted for the optical unit which is highly resistant to smoke and dusty environment, of long service life expectancy is introduced since the optical and display units are compatible, any combination can be continued. Therefore, since the optical unit is usable in all kinds of environments and enables measurements under adverse conditions with stability.

To improve wire production efficiency, the number of scanning times has been raised to 3,000 times/s, the highest, and the gauge is also able to detect short length, which previously have been difficult to measure with slower conventional types of gauges.

The new gauge features a wide measurement range of 0.21-30 mm, and its repetitive measurement accuracy is as high as 0.3 μm. When either the optical or processing unit becomes damaged, only the damaged unit needs to be replaced, making replacement after repair unnecessary. Thus enabling the unit to be kept as a spare. Therefore, time is saved in reactivating the system on the production line thus ensuring excellent maintainability.

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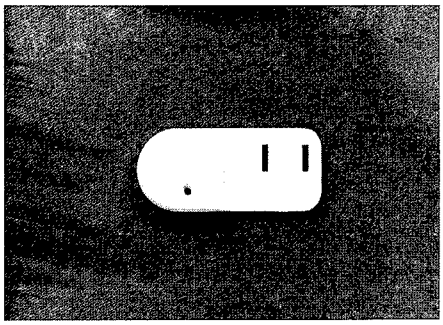
97-08-007-02

Apparatus to Protect Electrical Equipment from Thunderbolts

Noah Co., Ltd., has marketed the Thunderbolt Guard NE-777 that protects electrical equipment such as TV units, audio/video units, personal computers, word processors, air conditioning systems, telephones and facsimile systems from the high voltages generated by thunderbolts.

When thunderbolts strike, high voltages (thunderbolt surges) may reach electrical equipment before the home circuit breaker actuates, causing damage to electrical components such as wafers. Thunderbolt Guard incorporates a varistor and is designed to protect electrical equipment from thunderbolt surges of up to 6,000 V and 4,500 A. It was designed to cope with the rapidly increasing use of personal computers and other electrical equipment. Whenever some instantaneous thunderbolt surge strikes, Thunderbolt Guard absorbs instantaneous overvoltages and overcurrents (6,000 V and 4,500 A/ns) by varistor components . Then, cut off of A partial circuit and cut off B partial circuits by melting of solder when the temperature rises beyond 183 °C.

The varistor is 58 mm wide, 26 mm deep and 2.5 mm thick, and can be connected simply by inserting between the power receptacle and plug. A display lamp is lit to indicate at a glance that it has been actuated. Once actuated, the display lamp goes off, and the varistor is replaced at a domestic price of ¥800 apiece.



Thunderbolt Guard NE-777

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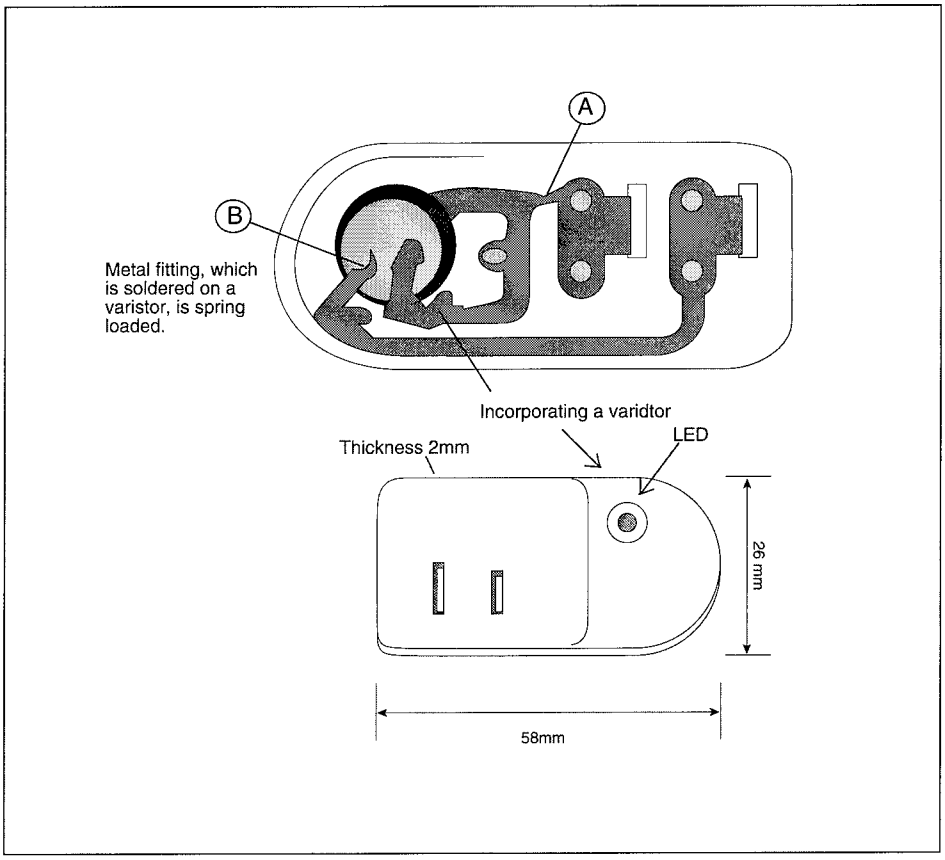


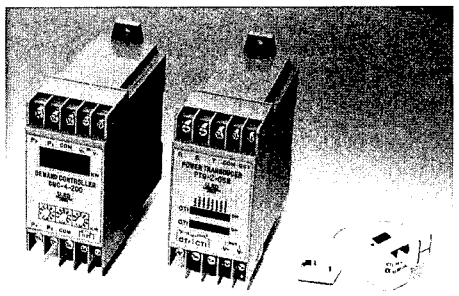
Block diagram

97-08-007-03

Easy, Low Cost and Versatile Power-Saving Modules for Electric Power Management and Control

U.R.D. Co., Ltd. has completed a series of Eco-Modules for business enterprises to introduce immediately for power-saving management. Modules are equipped with standard components such as a small clamp type current sensor, a power transducer which requires no PT, and a demand controller, and the targets of control are the adjustment of illumination equipment, temperature control of air conditioning systems and showcases, motor speed control, selective stopping of unnecessary equipment and other power-saving applications.

By using the Eco-Modules in combination with a U.R.D. transducer and demand controllers, power consumption can be used as a control signal to switch these equipment whenever the preset power consumption is attained. The accumulated power consumption of up to four transformer systems is computed with the demand controller and displayed, and when the demand value set beforehand with a digital switch is attained, a demand attainment signal is generated that is usable by the user for power-saving of various types of equipment.



Series of Eco-Modules

The system characteristics are that the demand controller can be connected to a maximum of four target transducers, small-scale transformers with a contracted power demand limit of more than 90 kW are controllable, easy operation simply by connecting to the cubicle transformer secondary side, or to the power source without having to use other devices, no permit acquisition is necessary for use as long as there is a corporate chief engineer, and the demand attainment signal is a non-voltage contact output, so versatile sequences can be executed to control other electrical equipment.

The system has an especially low cost of ¥ 150,000 (domestic price) for two channel transformers (i.e.: 2 types such as 1Ø-3 lines and 3Ø-3 lines)

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Mobile 3,600-kW generator truck

97-08-007-04
Mobile 3,600-kW Generator Truck

Hokkaido Electric Power Co., Inc. and Ishikawajima-Harima Heavy Industries, Ltd. have jointly developed a mobile 3,600-kW generator truck by investing a sum of about ¥500 million. The generator truck has the largest output in the country.

The truck will be used for emergency power backup by utilizing its mobility to cover Hokkaido's expansive area. The introduction of this large-capacity mobile generator truck enables optimum use in a wide area during any inadvertent power interruption or disaster to permit quick recovery. The introduction of this truck reduces the investment for power distribution line backup (looping), which translates into savings of about ¥9 billion in ten years.

This generator truck consists of a gas turbine generator truck (up to 25 t) and a control truck (up to 20 t), and can supply electricity of 20 A to 1,800 households even at -35 °C. The gas turbine is a remodeled aircraft engine and comprises a lightweight power generation facility of excellent reliability. System operation is by conversational type touch panel that enables the system to be operated with ease without having to rely on a procedures instructions manual. The gas turbine generator truck and the control truck are linked together with an optical fiber control cable that eliminates noise and other problems.

Hokkaido Electric Power Co. has delivered more than 20 units of compact mobile generator trucks of 50-kW class and one large-capacity 1,000-kW and one 1,600-kW truck until April last year.

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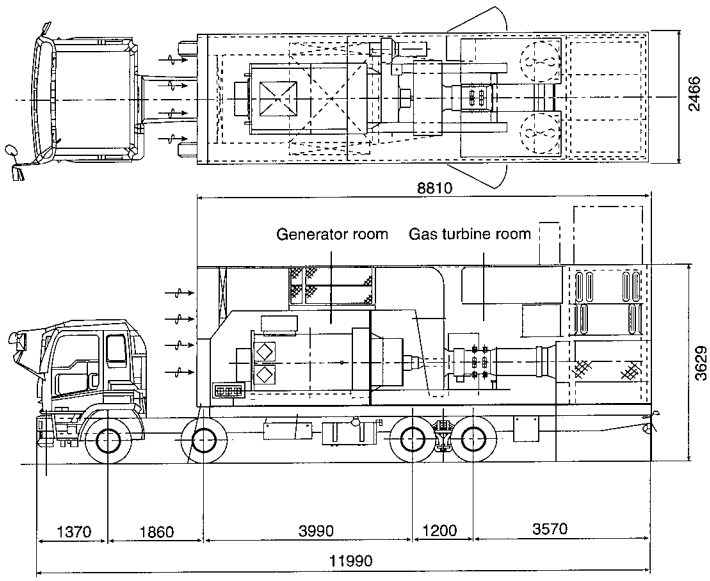
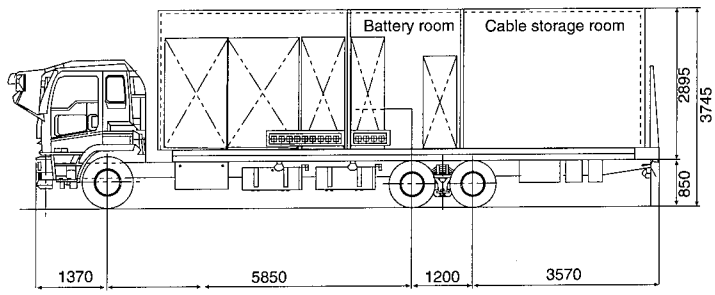
Mobile generator truck (3,600kW)



Gas turbine generator truck

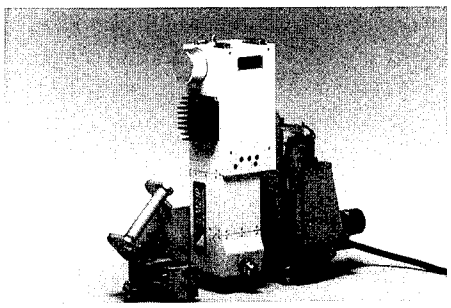


Control truck

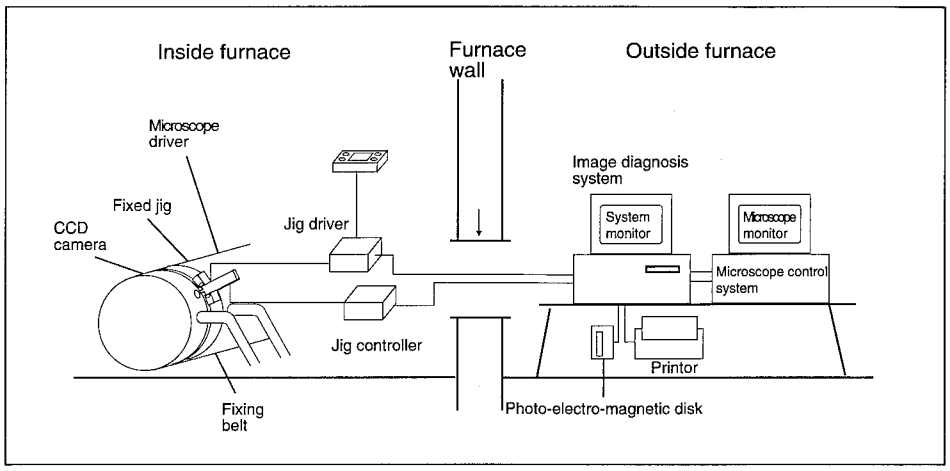
Dimensional drawing

97-08-007-05
System for Diagnosis of Residual Service Life of Boiler High-Temperature Steam Pipes

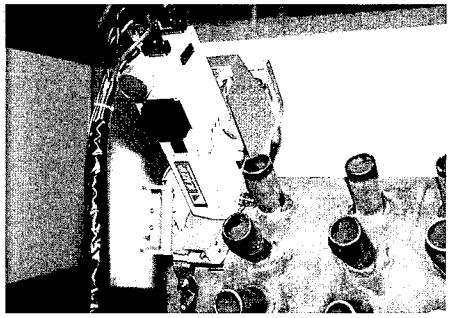
Chugoku Electric Power Co., Inc. and Ishikawajima-Harima Heavy Industries, Ltd. have jointly developed the world's first Boiler High-Temperature Steam Pipe



Boiler High-Temperature Steam Pipe Residual Service Life Diagnosis System



System construction chart



Observation status of the world's smallest laser microscope

Residual Service Life Diagnosis System for use by thermal power generators. This system uses the world's smallest laser microscope, enables on-the-site direct observation and elucidation of the boiler steam pipe deterioration with time, and diagnoses the residual lives of the steam pipes instantaneously at the inspection site.

The boiler steam pipes of thermal power generators are exposed to steam at extremely high temperatures and pressures, so extremely small creep voids are generated in their metal structures. The number of these creep voids increases as the boiler is used repeatedly and ultimately combine to generate cracks in the pipes, so it is necessary to assess the increase of these creep voids and to engage in proper repair work to prevent any major boiler problem.

The newly developed system enables the diagnosis to be accomplished rapidly, and therefore contributes to preventive maintenance and prolongs the lives of boilers. The system consists of a miniature laser microscope, a microscope control system and an image diagnosis system (personal computer). The laser microscope using a laser beam as its light source enables the parts of boiler high-temperature steam pipes affected by welding heat to be investigated directly and the data to be processed with an image diagnosis system, by which the state of creep void generation is assessed automatically. The areas of these voids are computed immediately.

The void area ratios of about 50 vision points in a diagnosis spot (1 mm^2 are computed automatically without duplication, and the tube residual service life evaluated immediately at the site. With conventional diagnosis systems, about six weeks had been necessary for obtaining the diagnosis results of one steam tube unit, but using the new system enables diagnosis results to be obtained for about five spots/day, so that a unit can be diagnosed in as little as about two weeks. In addition, the laser microscope size has been reduced to about 70% by an optimum arrangement of the laser path.

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Environment

97-08-008-01 Carbon Dioxide Separation Membrane

Kubota Corp. jointly with the Japan Fine Ceramics Center, has developed a ceramic carbon dioxide (CO_2) separation membrane capable of very efficiently extracting CO_2, the cause of global warming, from the gases exhausted by industrial plants. At room temperature, the membrane has been confirmed to extract CO_2 at a volume that is about 200 times that of nitrogen. The research team plans to develop membranes capable of resisting exhaust gases of higher temperatures and to establish a CO_2 recovery technology for preventing global warming.

More specifically, the CO_2 separation membrane was developed by a joint governmental and private sector research team consisting of Kubota, Corp., the Japan Fine Ceramics Center, Agency of Industrial Science and technology, Osaka National Research Institute, under the leadership of the New Energy and Industrial Technology Development Organization (NEDO).

The membrane has a two-layered construction in which a thin 0.5-μm film of substances consisting primarily of silicon dioxide is formed on the outside surface of a ceramic tube with a diameter of about 10 mm. The membrane surface is perforated with numerous 0.5~1.0 nm pores. The superthin film of substances consists primarily of silica and is coated on the surface of the alumina tube by the sol-gel process. A template agent is added to the sol-gel process starting-out material, which enables the fabrication of a thin membrane featuring CO_2 separation function.

Carbon dioxide has about the same molecular size as that of nitrogen that comprises the larger portion of exhaust gases, and filtration is therefore quite difficult, but the addition of the template agent draws carbon dioxide into the pores selectively for extraction through the tube. When a mixed gas consisting primarily of carbon dioxide and nitrogen was passed through the separation membrane, it was confirmed that only a small vol-

ume of nitrogen was passed through the membrane, whereas the CO_2 passage volume was 190-200 times that of nitrogen. Present separation membranes made of organic polymers are known to pass CO_2 by a volume that is only 10-50 times that of nitrogen, so the new ceramic separation membrane features a performance that is 4-20 times greater.

At high temperatures, gas molecules possess high levels of energy, making the separation of CO_2 and nitrogen difficult. The research team plans to further improve the new membrane separation properties by adding other types of high-performance organic substances and to develop a separation membrane enabling direct separation of CO_2 from exhaust gases of about 350 °C by FY 1999, for which the organic polymer membrane cannot be used.

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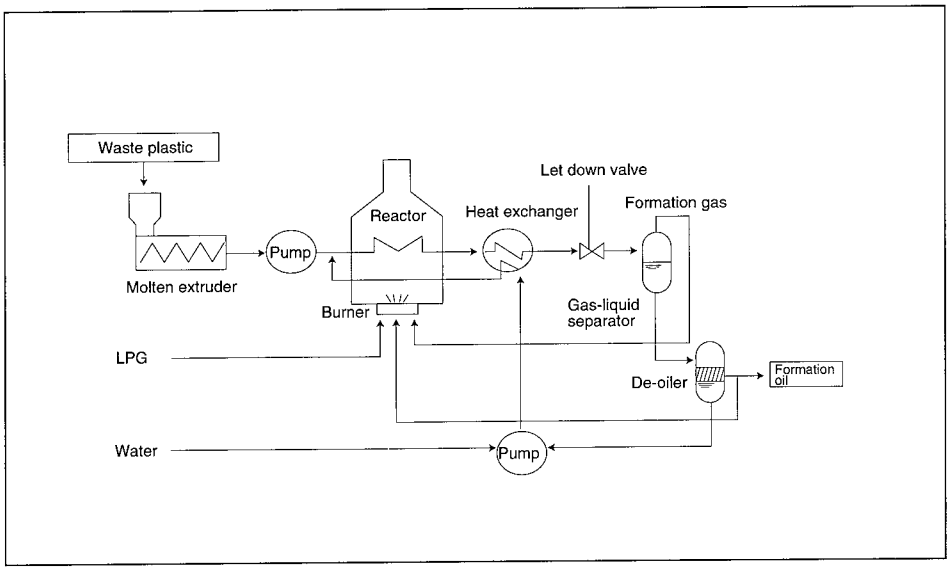


Waste plastics oleation system that utilizes supercritical water

97-08-008-02
Waste Plastics Oleation System

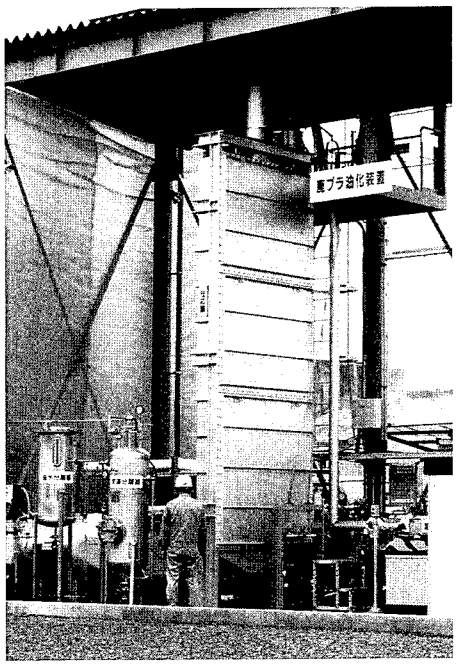
Tohoku Electric Power Co., Inc. and Mitsubishi Heavy Industries, Ltd. have jointly started full-scale demonstration tests with the objective of commercializing a waste plastics oleation system that utilizes supercritical water. A bright outlook has already been acquired to recover, in the form of oil, over 80% of the waste plastics fed inside a waste plastics continuous oleation system using supercritical water within a few minutes. The research project is to be continued up till FY 1999. Compared with oleation systems based on pyrolysis, the new system is distinct in that oil is recovered at a much lower cost, so the system's commercialization is expected.

The supercritical water is a special type of water existing in a non-gaseous or a non-liquid state at a high temperature and pressure (supercritical temperature of roughly 374 °C and supercritical pressure of over 22 MPa). More recently, the supercritical water is being applied to the decomposition treatment of environmental pollutants. Compared with existing oleation systems based on pyrolysis and other means, the new system enables high-speed plastics decomposition, can be designed compact and requires no catalyst, so the system is operable at a low cost.

Using supercritical water as the reactive solvent enables waste plastics to be oleated in the form of gasoline or grease with ease simply by controlling the treatment time and temperature as well as the water addition volume without using any catalyst or reagent other than water. There is hardly any generation of byproduct cokes, so the oleation ratio is remarkably high and the treatment accomplished in a short period of time, making the system ideal for the mass treatment of waste plastics. In addition, the water used as reactive solvent can be reutilized repeatedly, so the system hardly exerts any adverse influence to the surrounding environment.

Tohoku Electric Power Co. strove to commercialize the waste plastics oleation system using supercritical water from FY 1992, and entered into joint research with Mitsubishi Heavy Industries from October last year that possesses basic data relating to oleation reaction mechanism and analysis. A demonstration plant with a treatment capacity of 500 kg/day of waste plastics was installed in the latter's Hiroshima Laboratory and experimental operation was being continued.

Experiments corroborated that over 80% of the waste plastics charged into the system can be recovered as oil consisting primarily of light oil in a few minutes of treatment under the conditions of treatment temperature of 400-550 °C and pressure of 25-30 MPa, with hardly any generation of byproducts. Also, as compared with other oleation systems such as those based on pyrolysis, the treatment capacity per unit time is much greater, so system upscaling is possible with ease simply by increasing the number of reaction units. Therefore, the system can be installed in a small area, and oleation can be performed at a low cost due



Waste plastics oleation system

to the short treatment time and the disuse of catalysts. Further, the gas and oil generated through the processing of waste plastics can be reutilized as the heat sources for the reactors to render the system highly economical.

In the demonstration tests, the oleation conditions with respect to various types of waste plastics as well as the optimum conditions for waste plastics oleation are to be confirmed, while advancing studies to design the system most compactly. Tohoku Electric Power Co. plans to engage in joint research with North Japan Electric Wire Mfg. Co., Ltd., an affiliate, to construct a demonstration plant and to start continuous plant operation by using waste electric wire coatings with the objective of commercializing the system.

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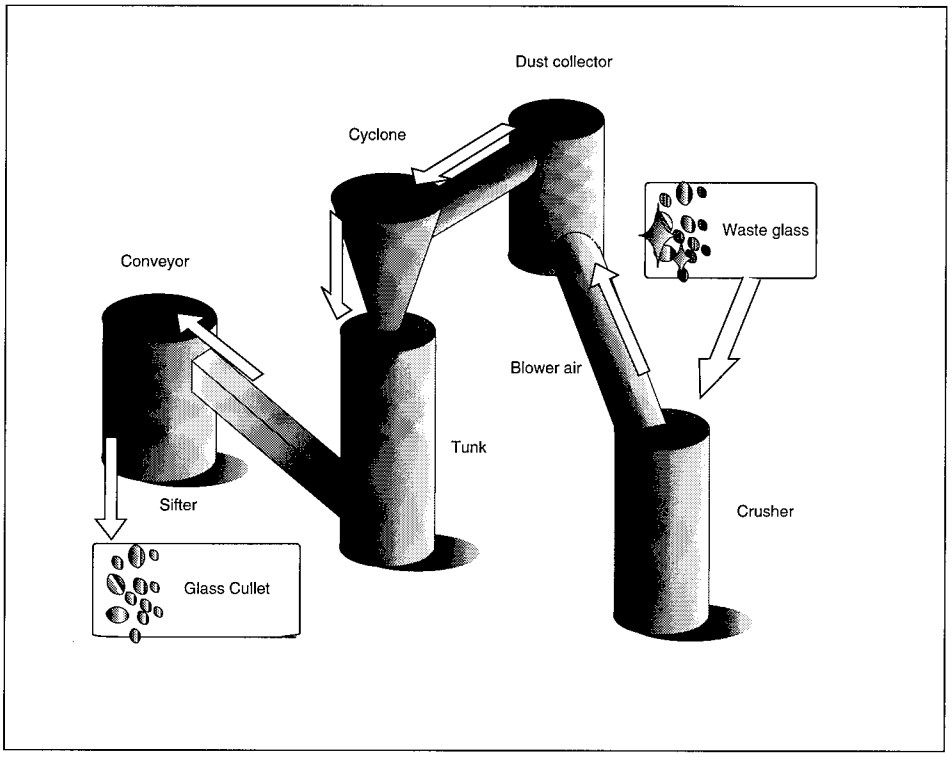


Flow chart

97-08-008-03

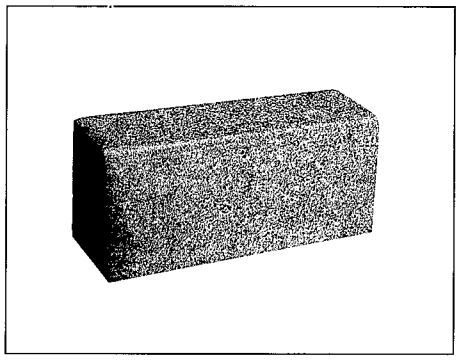
Pulverized Waste Glass Construction Aggregate and Pavement Block, Interior Tile Made of the Aggregate

Matsushita Sangyo Corp. has marketed a pulverized waste glass construction aggregate Glass Cullet, a pavement block Mirror Block, interior tile and Glass Tech made of the aggregate. Waste glass that is normally disposed of by land burial is recycled so decreasing the use of natural sand and to enable preservation of the natural environment as well as prolonging the service lives of refuse burial grounds.

In addition, the company has established a technique to polish the surfaces of its concrete product to draw out the intrinsic properties of glass such as its brilliant luster and reflection to provide the product with characteristics not displayed by conventional types of products. At the same time, the company's product, compared with conventional types of recycled products, uses a definitely larger volume of glass cullet. For example, the pavement block aggregate consists of 50-80% of glass cullet, which is one of the characteristics of the company's product. As a result, this technique can resolve the problems associated with the reuse of waste glass, and may resolve at a stroke the various problems associated with the recovery and reutilization of waste glass throughout the country.

The new construction material consisting of a mixture of waste glass reduces the environmental burden and enables the effective recycling of natural resources. The recycled products presently consist of a pavement block Mirror Block utilizing recycled waste glass and Glass Tech usable as an interior finishing material. Mirror Block displays a beautiful luster when polished and improves the surrounding environment and visibility. It features an excellent modal design and a brilliancy which are distinct and not displayed by natural stones. Glass Tech is a creative product differing radically from conventional types of terrazzo tiles, and features an excellent decorative attribute enabling flexible coloring by an appropriate blending of glass cullet and pigments.

Patent rights are being applied for in connection with these concrete products blended with Glass Cullet aggregate. The aggregate is sold at a domestic price of ¥30,000 per ton, and the pavement block in a type available at ¥11,000 apiece and a type available at ¥12,000 apiece.



Glass Tech

Glass Cullet

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Biotechnology & Medical Science

97-08-009-01

Mozuku Discovered to Be Effective Against O-157 Coli

M. Yakura of the R&D Center of Marine Products Kimuraya Co., Ltd. , and Prof. H. Matsuda of the Faculty of Biological Research and Science Shimane University, have discovered through a joint research project that mozuku, a seaweed of the Spermatochnaceae family, displays an antibiotic action against the pathogenic O-157 coli, and have applied for a patent right concerning the related technique.

Firstly, the pH values of the prepared Okinawan mozuku, prepared thin mozuku and prepared Mekabu (growing control part of seaweed) strain manufactured by the company were measured and these products sterilized. Next, these products were mixed with large quantities of Escherichia coli O-157: H7 and preserved at 10 °C. Products were cultured overnight in Luria-Bertani's (LB) medium, a culture bed for E. coli, with a composition of 10 g of polypeptone, 5 g of yeast extract, 10 g of NaCl per liter and pH value of 7.0, was diluted by 100 times with biological saline water, then 10 ml was added to 90 g of prepared Okinawan mozuku and other products, and various specimens were cultured. The bacteria was measured in conformance with the method generally adopted for food sanitation inspection.

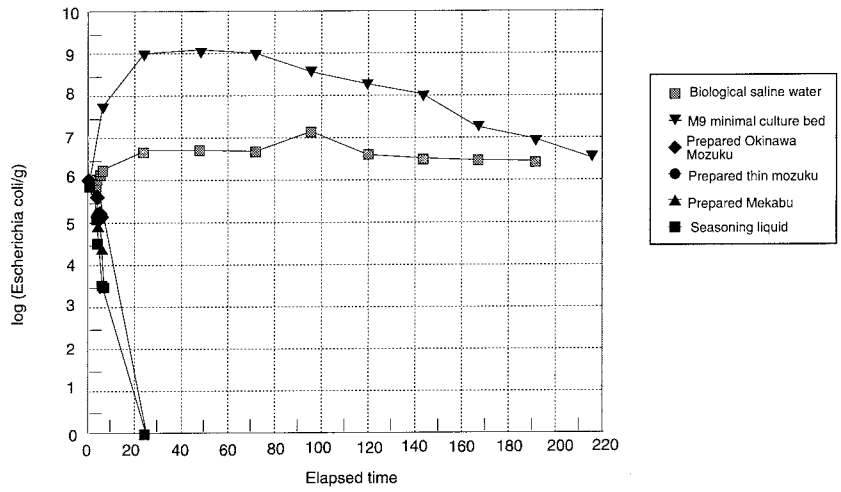
Prepared thin mozuku

One milliliter was sampled from each of the specimen culture beds, with 9 ml of sterilized biological saline water added, then diluted. One milliliter was sampled from these diluted liquids, 9 ml of biological saline water added for dilution to an appropriate level so that there were 30-300 colonies when cultured in an agar culture bed, followed with culturing in the LB agar culture bed (composition is as same as liquid and with an addition of 15 g of agar). The number of colonies was measured after culturing overnight.

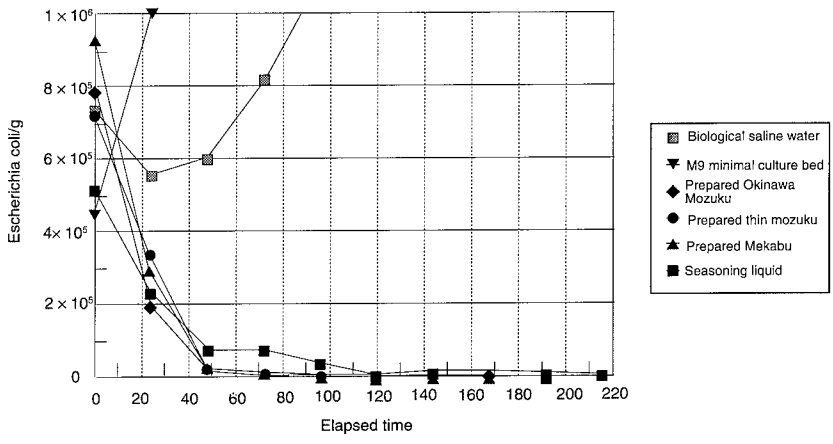
The control was biological saline water and M9 minimal culture bed (composition: 6g of Na_2PHO_4, 3 g of KH_2PO_4, 0.5 g of NaCl, 1 g of NH_4Cl, 0.4% of glucose, 0.1 mM of $CaCl_2$, 2 mM of $MgSO_4$, 1 mM of thiamine per liter and a pH value of 7.4), and similar experiments were conducted. Culturing was also performed at 37 °C. Similar experiments were conducted only with seasoning liquids for prepared Okinawan mozuki diluted to the same densities as prepared Okinawan mozuki and others, and the biologically active substances contained in mozuku were examined.

When O-157 was mixed to a fixed quantity into various specimen culture beds and cultured at 37 °C, the coli proliferated up to about 1×10^9 bacteria/g per day in the M9 minimal culture bed, and started to decrease from about the third day. At 37 °C, no coli was detectable after one day with

Antibiotic action of prepared mozuku against the pathogenic O-157 coli.(37°C)



Antibiotic action of prepared mozuku against the pathogenic O-157 coli.(10°C)



either prepared Okinawan mozuku, prepared thin mozuku, prepared Mekabu (growing control part of seaweed) strain and seasoning liquid. When preserved at 10 °C, the number of bacteria increased in the minimal M9 culture bed and in biological saline water, but the number decreased in other culture beds. The number of bacteria after implantation was 7.9×10^5/g with flavored Okinawan mozuku, 7.2×10^5/g with flavored threaded filament mozuku, 9.3×10^5/g with prepared Mekabu (growing control part of seaweed) strain, and 5.2×10^5/g with the seasoning liquid. The number of bacteria was reduced to about a millionth in 5 days with prepared thin mozuku, and in 8 days with prepared Mekabu (growing control part of seaweed) strain. The number was also decreased to 60 bacteria/g by the 9th day with prepared Okinawan mozuku, or to about a ten thousandth compared with the initial number. With the seasoning liquid, the number was decreased to 1.1×10^3 bacteria/g by the 9th day (about a thousandth compared with the initial number).

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97-08-009-02

Antiseptic-resistance Genes Isolated from Several Bacteria

Asst. Prof. M. Sasatsu at Showa College of Pharmaceutical Science and his coworkers have studied antiseptic resistance genes from several bacteria (mainly Staphylococcuss aureus).

Methicillin-resistant Staphylococcus aureus (MRSA) is resistant to most antibiotics, and recently some strains of MRSA have also acquired resistance to one or more antiseptics in the last few years such as Pseudomonas aeruginosa. The research team isolated MRSA strains resistant specifically to Triclosan (an antiseptic), butylparaben and methylparaben (preservatives for cosmetics), and povidoneiodine (a disinfectant for surgeons).

The gene controlling the antiseptic resistance was isolated from a transferable plasmid in a strain of MRSA, and the DNA sequence was fully determined. The MRSA cell with the gene has a membrane protein working as a channel pumping out one or, often more antiseptics. The research team was thus convinced of the existence of antiseptic-resistant bacteria other than P. aeruginosa and MRSA, and since then has engaged in seeking such bacteria. The research team has found similar genes present in Serratia, Vibrio parahaemolyticus, and Helicobacter pylori. Those bacteria often withstand more than one antiseptic. Serratia are omnipresent air- and water-borne bacteria, and particularly attack weak people and cause various diseases such as pneumonia, septic fever, and uropathy. Vibrio parahaemolyticus is a bacterium poisoning fishes and shells. Helicobacter pylori is a possible cause of gastric ulcer. The research team will now continue the search for other antiseptic-resistant bacteria.

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97-08-009-03

Stress Sensing Wire with Negative Magnetostriction

Prof. K. Mohri at Nagoya University and his colleagues discovered that an amorphous alloy wire of negative magnetostriction can sense small stresses when a high-frequency current is passed. The research team has made a ultra-sensitive stress sensor system from the wire, and demonstrated that the system can detect the Japanese vowel sounds and carotid artery pulsation waves.

The device is based on the impedance change ulilizing the skin effect of a high-frequency current in the wire for applying stresses.The skin depth changes with the wire circumferential permeability which is changed with applying stresses. Therefore, not only the inductance but also the resistance, that is the impedance, is changed with the stress. The research team previously established that a zero-magnetostrictive amorphous wire changes in impedance by more than 100% for each gauss increment of external magnetic field because of the skin effect of a high-frequency current applied to the wire. This giant magnetoimpedance (GMI) effect was developed into various magnetic field micro sensors.

A 30-μm-diameter wire of an amorphous cobalt-silicon-boron alloy was prepared. After cold drawing and then under-tension annealing, the thin wire exhibits magnetic properties uniform along the length. With negative magnetostriction, the wire has a strain-gauge factor (SGF) of more than 1200 when, for example, a 20-mA, 20-MHz current is passed. The SGF value is about 6 times as much as that of a piezoelectric silicon strain gauge, and some 600 times greater than the value with an electric resistance wire strain gauge. The SGF value of the wire with 20 μm diameter showed 5600.

The stress sensitivity of the wire stems also from the skin effect. When a high-frequency current is applied to a wire, between its ends is a voltage drop proportional to the square root of the product of the angular frequency of the current and the circumferential differential permeability of the wire. On the other side, when the wire is under stress, its deformation causes changes in permeability because of the reciprocity of magnetostriction. Stress on a wire thus leads to a voltage drop between the wire ends. This stress-impedance effect ensures that a wire can detect stress. The CoSiB wire has a giant stress-impedance (GSI), so stress detection is quite sensitive with extremely high value of SGF.

The research team made a prototype stress sensor system consisting of a piece of the CoSiB wire stuck on a non-woven diaphragm and a CMOS multivibrator for producing a train of sharp pulses inducing the skin effect. The prototype system could detect the waveforms of the Japanese vowel sounds (a, i, u, e, o) and the pulsing carotid artery. The detected vowel waveforms were well distinguishable from each other. The artery pulsation detector system is ready for a layperson to operate. Indeed in tests, subjects easily took pulsation records with the sensor placed on their neck by themselves. When the blood pressure and waveform of the pulsed artery are known, it is easy to estimate the cardiac output, the peripheral resistance, and the presence/absence of arteriostenosis.

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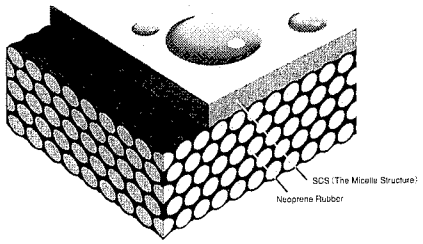
F L A S H

Swimming Wear Made of Superlow Water Resistance Functional Material



Construction of Super Composite Skin (S.C.S)

GOLDWIN moda Co., Ltd. will start selling from the coming autumn the new swimming wear Super ellesse that is made of a superlow water resistance functional material Super Composite Skin (S.C.S) that reduces the water resistance to very close to zero. Super ellesse was developed jointly by GOLDWIN moda and Yamamoto Chemical Industry Co., Ltd.

Super Composite Skin is an entirely new type of material that is obtained by processing neoprene rubber independent air bubbles with a special surface treatment technique. As a result, due to the effect of the micelle structural molecules on the rubber surface, the water flows very smoothly along the micelle molecules when swimming, by which the water resistance is reduced considerably to reduce the surface frictional resistance to a superlow resistance coefficient of 0.032 close to that of ice, so the water resistance is reduced to about 1/40th compared with the conventional type of nylon swimming wear.

The commercial swimming wear for women uses S.C.S from the under bust side to the waist, and high-power composite around the legs to enable water to be adsorbed and expelled naturally to increase the swimming speed considerably due to the superlow resistance in water. Men's swimming suits use S.C.S. entirely to decrease the water resistance to close to zero, while the front side seam was eliminated to enable the legs to be moved smoothly while alleviating the load on the thighs. Up till now, swimming wear made of synthetic chloroprene rubber (neoprene rubber) had the disadvantages of poor water drain and sense of poor fit, but employing S.C.S. using elastic rubber has eliminated these inconveniences and improved the properties of swimming wear substantially.

Models of men's and women's swimming suits in two colors will be marketed this autumn, with the men's model sold at a domestic price of ¥5,600 and the women's model at ¥13,000. The company plans to expand the range of models.

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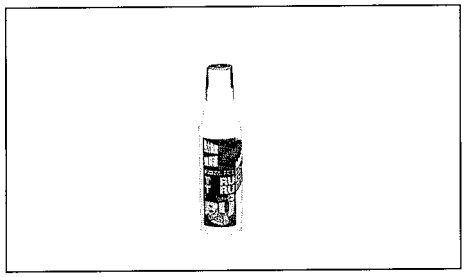
Special-Purpose Plant for Manufacturing Bamboo Vinegar



Bamboo vinegar

YAMAGISHI Industrial Co., Ltd. has developed a special-purpose plant for manufacturing bamboo vinegar and has succeeded in extracting colorless, transparent bamboo vinegar from bamboo without using a burner.

Bamboo vinegar raw liquor is a black liquid obtained by recovering the vapor generated in the process of combusting thick-stemmed bamboo (Phyllostachys pubescens) with a carbonization furnace. This raw liquor is sterilized, deodorized and refined to obtain a colorless, transparent bamboo vinegar. Due to the multiple effects of the vinegar components for neutralization and masking, the bamboo vinegar features an excellent deodorizing effect and for ammonia, in particular, has a deodorizing effect of over 95%. It also displays a remarkable sterilization effect with respect to salmonella, enteritis vibrio, Staphylococcus aurreus, E. coli, MRSA and other bacteria.

Up till now, the company used to procure its necessary supplies of raw bamboo vinegar liquor from the process of manufacturing bamboo carbon (activated carbon). However, brisk demand has made this source inadequate, so the company developed a plant to extract bamboo vinegar raw liquor from thick-stemmed bamboo that grows profusely in Oita Prefecture. The bamboo vinegar raw liquor obtained by cooling the vapor generated when combusting the bamboo is refined by a unique technique to become colorless and transparent. Since no burner is used, there is no hazard of kerosene impurities becoming mixed into the vinegar liquor, so quality bamboo vinegar is produced reliably.

The Kunimi Plant for manufacturing the bamboo vinegar raw liquor has a site of 1,000 m^2, is a flat building with a floor area of about 200 m^2, and was constructed with an investment of about ¥70 million.

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JETRO

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Machinery and Technology Department